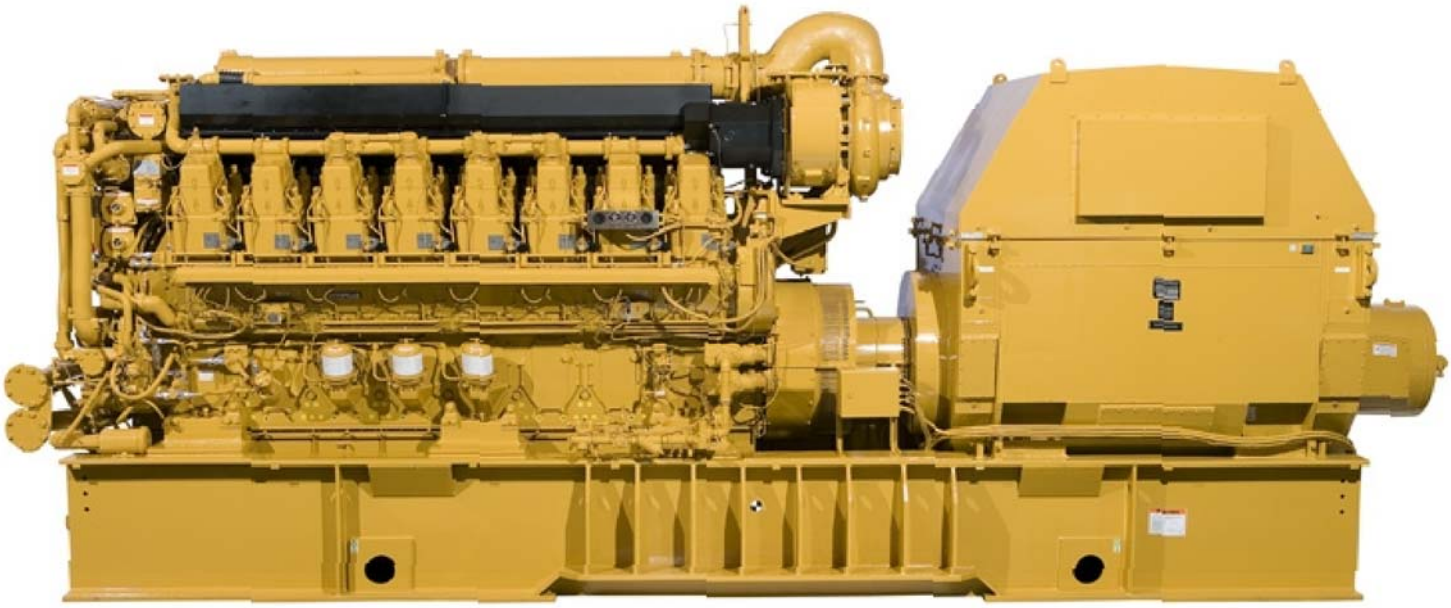
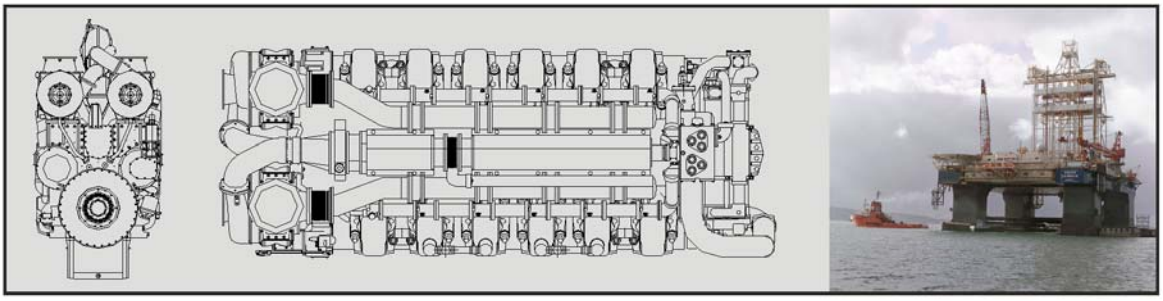
C280/3600

Petroleum Offshore Project Guide





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Introduction

Engine Selection

The use of Caterpillar engines in Petroleum Offshore applications requires specific considerations for engine selection and installation to ensure dependable performance and a long, trouble-free life.

The table below provides guidance on selecting the appropriate Caterpillar C280/3600 engine based on the customer specification. An IMO emissions certified engine is the minimum requirement for operation offshore and the 3600 IMO certified engine provides the customer with the lowest initial installation cost. If the customer is interested in reducing their fuel cost, the C280 IMO certified engine provides the best fuel consumption for this engine family. Alternatively, if the customer specifies “Latest Engine Technology,” the C280 IMO certified engine provides an electronically controlled fuel system over the mechanically controlled 3600 IMO engine. Lastly, if the customer specification details either EPA Marine Tier 2 or “Latest Emission Technology,” the C280 EPA Marine Tier 2 engine is the engine of choice providing ECM software design to electronically control fuel injection to meet EPA Tier 2 emission requirements. Specific rig cooling system requirements for each of these engines are detailed in the Cooling System section of this guide.

Engine Selection Table			
Customer Requirements	**C280 EPA Tier 2**	**C280 IMO**	**3600 IMO**
EPA Marine Tier 2	✓		
“Latest Emissions Technology”	✓		
“Latest Engine Technology”		✓	
Better Fuel Consumption		✓	
Lowest Installation Cost			✓

Engine and Generator Set Ratings

For offshore drilling rigs, Caterpillar provides Prime engine ratings designed for 60% Load Factor and 6,000 operating hours per year. These ratings have an additional 10% overload capability for one hour of operation over a 12 hour period. Generators supplied by Caterpillar are rated for continuous operation. This type of package allows the generator set to be operated above the 60% load factor for extended periods of time due to weather related situations with only a minor reduction in Time Before Overhaul hours.

For other applications, site load requirements and number of operating hours should be reviewed with a Caterpillar dealer to determine the best product and rating fit for the application.

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Basic C280/3600 Diesel Engine Design

The C280/3600 Engine Family for offshore platform applications is a modern, highly efficient, IMO certified engine series consisting of in-line engines of 6 and 8 cylinders and vee engines of 12 and 16 cylinders. These are four stroke, non-reversible engines rated at speeds from 900 to 1000 rpm and intended for use as generator drivers for offshore platforms. The engines are turbocharged, charge air cooled and with a direct injection fuel system using unit fuel injectors. The use of individual fuel injectors eliminates the need for high pressure piping and provides for an accurate, high injection pressure.

The engine block is a nodular cast iron block. The intake plenum runs the full length of the engine, providing even air distribution to the cylinders.

The crankshaft is a pressed forging that is induction hardened. A counter-weight for each cylinder is bolted to the crankshaft using a robust 3 bolt design. Crankshaft end flanges are identical so full power can be taken off from either end.

The main, rod and camshaft bearings are steel-backed, nickel bonded aluminum with a lead-tin overlay, copper-bonded to the aluminum. Experience has shown this produces the best bearing construction available for the longest possible life.

The connecting rods are forged, heat treated and shot peened before machining. The special four-bolt design allows for an extra-large bearing which reduces bearing load and extends bearing life.

The cylinder liners are high alloy iron castings, induction hardened, plateau honed and water jacketed over their full length. The liners are equipped with an anti-polishing ring (cuff) to avoid piston / liner carbonizing and thus improve lube oil control and liner life.

The pistons are two-piece with a steel crown and forged aluminum skirt for excellent strength and durability, yet light weight. Each piston has four rings, two in hardened grooves in the crown and two in the skirt. The top compression ring is asymmetrically faced with a chrome-ceramic matrix coating to provide extended ring and liner life. The two middle rings are taper faced and chrome plated, while the lower lube oil control ring is double rail chrome faced, with a spring expander. Oil is jet sprayed into passageways within the pistons for cooling and lubrication of the piston pin.

The valve configuration features induction-hardened replaceable valve seat inserts. Positive rotators on all the valves maintain a uniform temperature and wear pattern across the valve face and seat. The exhaust and air inlet valves are both manufactured from Nimonic 80A material.

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Example Diesel Generator Package Scope of Supply

The following is a typical scope of supply for an offshore semi-submersible drilling rig diesel generator package. This is an example only; the scope of supply varies with the application to meet specific customer needs, based on additional options discussed in the system sections.

Scope of Supply

Caterpillar C280-16 Diesel Generator Package

General Technical Data	
Model	Caterpillar C280-16 Diesel D/G Package
Engine Rating	5060 bkW at 900 rpm, prime power (IMO/EPA Marine Tier 2)
Package Rating	4840 ekW, 11,000 vac, 3 phase, 60 hertz
Ambient Conditions	45°C (113°F) Air, 38°C (100°F) water to aftercooler (IMO) 45°C (113°F) Air, 32°C (90°F) water to aftercooler (Tier 2)
TBO	Between 36,000 and 40,000 Hours
BSFC	188.4 g/bkW-HR + 5% Tolerance (ISO)
No. of Cylinders	16
Cylinder Configuration	VEE
Bore	280mm (11 in.)
Stroke	300mm (11.8 in)
Compression Ratio	13:1
Rotation	SAE Standard (CCW viewed from flywheel end)
Service Side	Optional (Left or Right Side)
Water Connections	Optional (Left or Right Side)
*Contact Caterpillar for the latest Technical Data	

Generators

Caterpillar C280/3600 Offshore Generator Sets are packaged with free-standing two-bearing generators, matched to the engine output to provide the customer maximum electrical output to meet their requirements, as well as marine classification requirements for the application. Generator specifications and generator testing requirements will need to be reviewed during the pre-sale phase of the project and established prior to order placement. Options to be considered should include sub-transient reactance needed to meet transient responses required and type of current transformers to be mounted and supplied for the project.

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Air Inlet System

Included Components

- Aftercooler, Fresh Water, Corrosion Resistant Coated (Air Side)
- Air Inlet Shutoff
- Crankcase Breather, Top Mounted
- Turbochargers, Rear Mounted, Engine Oil Lubricated
- 90° Air Inlet Elbows with Air Cleaner Adapters

Options

- Air Cleaners, Standard Duty, Normal Volume with Soot Filters

Exhaust System

Included Components

- Dry, Gas Tight, Exhaust Manifold with soft Manifold Shield

Options

- Outlet Expanders, 355 mm (14 in.) to 457 mm (18 in.)
- Flexible Exhaust Fittings, 457 mm (18 in.)
- Exhaust Weld Flanges, 457 mm (18 in.)

Cooling System

Included Components

- Engine Coolant Water Drains
- Separate Circuit (optional Combined Circuit Cooling System - see Cooling System section for description of these systems)
- Separate Circuit, 3 Element Oil Cooler
- Thermostat Valves: 3 Way 90°C (194°F) for JW Circuit and 32°C (90°F) for AC/OC Circuit
- High Volume, Accessory Module Mounted, Expansion Tank
- Fresh Water Pumps, Engine Driven, JW and AC/OC Pumps

Options

- Jacket Water Heater, Base Mounted, 30 kW
- Heat Recovery Connections with 3-Way Thermostatic Valve
- Optional 93°C (199°F) JW Circuit Thermostats for Heat Recovery
- Cooling System Custom Attachments Include:
- Accessory Module with Plate type J.W. and AC/OC Heat Exchangers

Fuel System

The fuel system is designed for distillate fuel, requiring viscosity ranging from 1.4 cSt to 20 cSt at 38°C (100°F).

Included Components

- Direct Injection System with Electronically (C280) or Mechanically (3600) Controlled Unit Injectors

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- Fuel Transfer Pump, Engine Driven, Mounted on Left Hand Side
- Duplex Fuel Filters, with Service Indicators, Engine Mounted

Options

- Manual Fuel Priming Pump
- Duplex Primary Fuel Strainer
- Flexible Hoses

Custom Attachments

- Fuel Cooler, Plate Type, Mounted on Accessory Module

Lube Oil System

The Lube Oil System utilizes a custom dry sump base assembly with an integral sump in the base for 15° static and 25° dynamic tilt capability.

Included Components

- Lube Oil Pump, Engine Driven
- Lube Oil Cooler, Shell & Tube Type, Engine Mounted
- Thermostatic Valve for Lube Oil Temperature Control
- Duplex Oil Filter, Engine Mounted
- Oil Filler and Dipstick
- Priority Valve for Oil Pressure Regulating
- Crankcase Explosion Relief Valves
- Redundant Pre-Lube System with Air Driven Intermittent Pre-Lube Pump and Electric Motor Driven Continuous Pre-Lube Pump
- Lube Oil System Options include:
- Manual Oil Pan Drain Valves, Front and rear
- Electric oil heater (9 kW for In-line engines and 11 kW for Vee engines)
- Lube Oil System Custom Attachments include:
- Generator Lube Module (GLM) for Kato Generators
- For generators supplied by others, generator manufacturer is responsible for providing any forced lubrication system that may be required for their generator to meet tilt requirements

Starting System

The Starting System is an indirect air starting system.

Included Components

- Dual Starting Motors, TDI

Options

- Pressure Reducing Valve

Control System

The control system uses a single Caterpillar ADEM A3, Electronic Engine Control Modules with Electronic Unit Injection Fuel System.

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Included Components

- Rigid Wiring Harness

Options

- Direct Rack Module available for C280 engines

Protection System

The protection system is a PLC (programmable logic controller) based system that provides protection, monitoring, and control housed in a NEMA 4 (IP66) enclosure. All critical shutdowns have both relay and PLC based protection. Sensors are factory wired directly to an engine mounted terminal box for a ship loose package or an engine only selection. Sensors are wired directly to the control panel when an accessory module is ordered and is factory packaged; otherwise control panel is shipped loose for customer mounting. Use of PLC eliminates the need for a separate gauge panel and annunciator panel.

Features

- 254 mm (10.0 in.) color monitor to display all engine parameters and alarm annunciation. The color monitor has a general overview screen, an exhaust screen, lube oil screen, cooling screen, air and fuel screen and an auxiliary screen.
- The alarms are annunciated with a time & date stamp.
- Annunciation of all engines shutdowns, alarms and status points.
- Start/prelube control switch, fuel control switch and emergency stop button.
- Selection of local/remote control of engine.
- Selection of idle/rated control of engine.
- Equipped for remote communication.
- Four 4-20 mA outputs (programmable).
- Relay contact signals to the remote monitoring system (summary shutdown, summary alarm, local operation/remote, engine running, PLC failure, fuel control and idle/rated).

Engine Sensors

All package mounted sensors are wired to a common junction box.

The following are the different sensor types and their descriptions:

Contactors

- Lube oil pressure (hi/low speed)
- Jacket water pressure
- AC/OC pressure
- Start air pressure
- Crankcase pressure.

4-20 mA Transducers

- Lube oil pressure (to filter/to engine)
- Fuel pressure (to filter/to engine)
- Inlet air manifold pressure.

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RTD (PT100)

- Lubricating oil to engine temperature
- Inlet air manifold temperature
- Fuel to engine temperature
- AC/OC inlet temperature
- Jacket water outlet temperature (alarm)
- Jacket water outlet temperature (shutdown)
- Generator rear bearing temperature (Genset only)
- Generator front bearing temperature (Genset only)
- Generator stator A temperature (Genset only)
- Generator stator B temperature (Genset only)
- Generator stator C temperature (Genset only).

Switches

- Jacket water detector
- Metal particle detector
- Starting oil pressure or detector

Thermocouples

- Exhaust thermocouples (one per cylinder plus inlet to turbine and stack)

Interfacing

The engine is factory equipped with the required sensors needed for the PLC. It accepts remote signals for starting/interlock, stopping and emergency stop. All monitored parameters and status are available on DH+ network. An Ethernet connection is available by Custom Quote. MODBUS communication is available in optional feature code selection.

Alarms

Pressure

- Low oil pressure
- High oil filter differential
- Low fuel pressure
- High fuel filter differential
- High inlet air manifold pressure
- Low starting air pressure
- Low jacket water pressure
- Low AC/OC water pressure
- Low raw/sea water pressure (customer supplied contact).

Temperature

- High lube oil temperature
- High inlet air manifold temperature
- High fuel temperature

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- High AC/OC inlet temperature
- High jacket water outlet temperature
- High generator rear bearing temperature (Genset only)
- High generator front bearing temperature (Genset only)
- High generator stator A temperature (Genset only)
- High generator stator B temperature (Genset only)
- High generator stator C temperature (Genset only)
- High individual exhaust port temperature
- High turbine inlet temperature
- High exhaust stack temperature
- High exhaust port deviation temperature.

Other

- Low battery voltage
- Low oil level
- Jacket water detection
- Low coolant level (Switch supplied with an expansion tank or customer supplied if an expansion tank is not selected).
- Metal particle detection.

Shutdowns

Pressure

- Low oil pressure
- High crankcase pressure.

Temperature

- High jacket water temperature
- High lube oil temperature
- High generator bearing temperature (Genset only).

Other

- Metal particle detection
- Engine overspeed
- Customer shutdown (normally open contact customer supplied).

Programmable Inputs

The customer can wire, display and alarm on two customer supplied RTD's, and two customer supplied 4-20 mA (0-10 VDC) sensors, three discrete alarms, and three discrete shutdowns.

Gauges

In addition to the 254 mm (10 in.) color monitor that displays all engine parameters, there are three engine mounted gauges and three control panel gauges. The three engine mounted gauges are fuel pressure, lube oil pressure, and inlet air restriction. The three control panel gauges include an engine hour meter, digital tachometer, and a starting air pressure gauge.

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Lights

Four lights are included on the control panel for displaying prelube status, summary alarm, summary shutdown, and PLC failure.

Construction

- Enclosure – NEMA 4 (IP66).

PLC Monitoring System Options

AC/OC/JW/Air Start/Upgrade/Vee

- Upgrades AC/OC, JW and starting air pressure from contactors to 4-20mA transducers.

Raw/Sea Water Pressure Transducer

- Adds a raw/sea water transducer.

MODBUS Communications

- Adds a MODBUS card to panel.

Beacon and Horn

- Provides a beacon and horn assembly to panel.
- Assemblies are shipped loose.

Single Engine REM Display Monitor

- A remote 254 mm (10 in.) color PLC display/monitor to display all engine parameters and annunciation.
- The monitor is identical to the one in the face of the standard PLC panel.
- The unit is shipped loose.

Cabinet Cooler

- Customer mounted air powered cabinet cooler.
- Includes cooler, filter, solenoid and thermostat.
- It requires 552 to 690 kPa (80 to 110 psig) clean, dry air.
- Recommended for applications where ambient air temperature exceeds 50°C (122°F), but does not exceed 60°C (140°F).

Power Monitoring/Gen Set

- A multifunction digital power monitor is shipped loose for installation within the switchgear or generator control panel.
- The power monitor communicates with the PLC and displays parameters such as voltage, current, kW, kVAR, pf, frequency, kW hours and kVAR hours on the GMS monitor.

Turbocharger Speed Sensor

- Provides two speed sensors, one for each turbocharger, so turbocharger speed may be monitored.

Cylinder Pressure Relief Valve

- Includes sixteen relief valves.
- Meets major marine society requirements.
- Engine mounted in cylinder heads.

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- Automatic combustion chamber pressure relief at marine society specified over-pressure level.

Mechanical Cylinder Pressure Gauge Valve

- Includes sixteen valves.
- Engine mounted on cylinder heads.
- Accepts mechanical cylinder pressure gauge (not included).
- Manual compression release capability when gauge is not installed.
- Software thermal shielding is included.

Oil Mist Detector

- Installed on side opposite of service side on rear mounted turbo configurations.
- System required by marine societies for “Alarm and Safety Requirements for Unmanned Machinery Space (UMS)” under the following conditions:
  - For DNV: An engine rating greater than or equal to 2250 kW or an engine bore size greater than 200 mm.
  - For ABS, BV, GL, LRS, RINa: An engine rating greater than or equal to 2250 kW or an engine bore size greater than 300 mm.

Oil Mist Detector Drain Group

- Provides oil drain for use with oil mist detector.

Protection System Components

Fuel Temperature Sensor:

- Provides fuel temperature sensor group.

VTC Air Restrict

- Provides air restriction instrument panel lines for VTC turbocharger.

Magnetic Pickup

- 4 hole Magnetic Speed Pickup Bracket: Bracket provides four locations for the installation of additional magnetic pickups.
- Does not include magnetic pickups.

Other Equipment in Main Components

- Integral Sump Base Assembly
- Vertically Restrained Vibration Isolators for Packaged Diesel Generator Set
- Torsional Coupling
- MCS Engine Certificate
- GL Approved IMO Certificate
- Engine Lifting Eyes (Shipped Loose)
- Accessory Module
- High Inertia Flywheel with Guard
- Damper with Guard
- Electric Barring Device
- Shrink Wrap & Tarpaulin Protection for Transportation and Storage

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Other Optional Equipment
- Isolator Weld Plates for Connection of Vibration Isolators to Customer Foundation

Optional Marine Safety Requirements
- Spray Shielding

Optional Spare Part Kits

Intake and Air System
- Air/Exhaust Common
- Exhaust Bellows Kit
- Turbo Kit

Basic Engine
- Basic Engine Kit
- Piston Assembly Kit
- Cuffed Liner Kit
- Bearing Spare parts Kit
- Rod Assembly Kit

Cylinder Head
- Head Kit – Common
- Gasket (Cuffed Liner)

Fuel System
- Fuel Kit – Common
- Injector Kit – Distillate Fuel

Cooling System
- Cooling System Kit – Common

Instrumentation
- Instrument Kit – Distillate Fuel

Cylinder Valve Kit
- Valve Kit – Distillate Fuel

Optional Engine Testing
- Turbocharger and Crankshaft Work Certificates
- Torsional Vibration Analysis of Generator Set
- Customer Witness Test
- Marine Society Certification Witness Test

Optional Service Tools, Shipping Protection, and Factory Support
- Factory Commissioning
- Specialized Tooling Group
- Turbocharger Tool Group
- Cylinder Head Repair Tool Group

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- Protection System Calibrator
- Oil Mist Detector Tool Kit
- Storage Preservation

Optional Literature

- Installation Drawings
- Additional Literature Set
- Additional Parts Book – CD
- Additional Service Manual
- Additional Technical Manual
- Paper Parts Book – English

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Technical Data

C280/3600 Technical Data Sheets

The following Technical Data Sheets represent the latest available 3600 and C280 series technical information at the time of publication and are subject to change. Consult with a Caterpillar dealer to obtain the most current data.

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3606 Technical Data - 900 rpm

3606 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2090	1900	1425	950
GENERATOR POWER		(2)	ekW	2002	1820	1365	910
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.0%	42.2%	42.3%	40.1%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	40.7%	41.0%	41.0%	38.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	201.6	200.4	200.3	211.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	205.6	204.3	204.2	215.2
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	207.6	206.5	206.7	218.0
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	208.7	191.9	146.3	103.0
AIR MASS FLOW			kg/hr	13968	12842	9792	6896
COMPRESSOR OUTLET PRESSURE			kPa (abs)	315.0	279.3	185.5	100.9
COMPRESSOR OUTLET TEMPERATURE			°C	235.4	217.4	169.5	117.0
INLET MANIFOLD PRESSURE			kPa (abs)	315.5	279.7	185.6	100.8
INLET MANIFOLD TEMPERATURE			°C	56.9	54.0	47.5	44.2
TIMING		(9)	°BTDC	12.5	12.5	12.5	12.5
EXHAUST STACK TEMPERATURE			°C	380.9	374.7	375.2	375.9
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	446.0	405.0	311.0	219.0
EXHAUST GAS MASS FLOW			kg/hr	14399	13233	10084	7098
EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	10.42	10.76	11.52	12.47
CO		(3)	g/bkW-hr	0.92	0.82	0.81	1.14
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.81	0.81	0.95	1.29
Particulates		(3)	g/bkW-hr	0.24	0.24	0.25	0.24
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	5134	4637	3473	2440
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	411	387	325	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	103	93	69	49
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	203	192	166	140
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	1577	1428	1103	824
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	1176	1098	846	630
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	738	628	378	216

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

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3606 Technical Data - 1000 rpm

3606 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2233	2030	1523	1015
GENERATOR POWER		(2)	ekW	2134	1940	1455	970
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	40.8%	41.4%	41.5%	39.7%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	39.6%	40.2%	40.2%	38.5%

ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	209.0	205.6	205.2	214.3
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	213.0	209.6	209.1	218.5
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	215.1	211.8	211.6	221.3
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	224.1	211.4	163.4	114.5
AIR MASS FLOW			kg/hr	14999	14146	10939	7660
COMPRESSOR OUTLET PRESSURE			kPa (abs)	281.9	256.9	188.1	113.4
COMPRESSOR OUTLET TEMPERATURE			°C	215.1	197.6	155.9	107.6
INLET MANIFOLD PRESSURE			kPa (abs)	290.7	266.2	184.4	99.4
INLET MANIFOLD TEMPERATURE			°C	45.9	43.9	39.9	36.6
TIMING		(9)	°BTDC	12.0	12.0	12.0	12.0
EXHAUST STACK TEMPERATURE			°C	407.7	384.7	376.7	383.5
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min				
EXHAUST GAS MASS FLOW			kg/hr	15487	14584	9259	7888

EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	7.96	8.19	8.99	9.36
CO		(3)	g/bkW-hr	1.33	0.95	0.77	1.04
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.70	0.85	1.01	1.21
Particulates		(3)	g/bkW-hr	0.16	0.17	0.22	0.30

ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	5645	5053	3785	2637
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	434	402	329	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	113	101	76	53
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	223	213	189	164
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	1856	1636	1251	922
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	1222	1197	952	678
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	789	672	418	226

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

5/23/2003 **DM5425 - 02**

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3608 Technical Data - 900 rpm

3608 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	175-6670
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2783	2530	1898	1265
GENERATOR POWER		(2)	ekW	2662	2420	1815	1210
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	43.6%	43.6%	43.5%	41.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	42.2%	42.3%	42.2%	39.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	194.5	194.1	194.9	205.9
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	198.2	197.9	198.7	209.9
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	200.3	200.1	201.2	212.7
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	287.1	265.1	191.1	121.4
AIR MASS FLOW			kg/hr	19217	17745	12790	8127
COMPRESSOR OUTLET PRESSURE			kPa (abs)	318.4	283.1	177.9	80.2
COMPRESSOR OUTLET TEMPERATURE			°C	218.2	199.5	149.2	94.8
INLET MANIFOLD PRESSURE			kPa (abs)	317.6	282.1	176.5	79.0
INLET MANIFOLD TEMPERATURE			°C	47.7	45.2	45.6	44.7
TIMING		(9)	°BTDC	11.0	11.0	11.0	11.0
EXHAUST STACK TEMPERATURE			°C	367.4	359.8	399.3	454.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	597.5	545.0	417.8	288.2
EXHAUST GAS MASS FLOW			kg/hr	19771	18248	13168	8393
EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	8.56	9.00	10.83	12.08
CO		(3)	g/bkW-hr	0.92	0.78	0.70	1.20
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.72	0.73	0.91	1.04
Particulates		(3)	g/bkW-hr	0.18	0.18	0.22	0.29
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	6587	5980	4500	3169
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	547	515	433	343
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	132	120	90	63
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	269	255	221	186
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	1964	1783	1430	1067
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	1568	1482	978	584
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	851	717	322	99

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

5/22/2003 **DM5430 - 05**

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3608 Technical Data - 1000 rpm

3608 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	200-8031
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2981	2710	2033	1355
GENERATOR POWER		(2)	ekW	2860	2600	1950	1300
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.3%	42.7%	42.4%	40.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.0%	41.4%	41.1%	39.0%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	199.6	197.8	199.5	210.7
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	203.5	201.7	203.4	214.7
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	205.5	203.9	205.9	217.5
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	324.9	296.9	218.7	140.1
AIR MASS FLOW			kg/hr	21746	19873	14634	9379
COMPRESSOR OUTLET PRESSURE			kPa (abs)	341.3	301.4	195.8	95.3
COMPRESSOR OUTLET TEMPERATURE			°C	219.1	202.2	155.5	100.1
INLET MANIFOLD PRESSURE			kPa (abs)	339.2	299.5	194.2	94.9
INLET MANIFOLD TEMPERATURE			°C	47.4	45.9	42.9	42.8
TIMING		(9)	°BTDC	12.5	12.5	12.5	12.5
EXHAUST STACK TEMPERATURE			°C	351.1	349.5	383.9	432.1
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	658.5	600.0	466.6	321.7
EXHAUST GAS MASS FLOW			kg/hr	22357	20423	15050	9669
EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	8.27	8.64	9.71	10.95
CO		(3)	g/bkW-hr	1.00	0.77	0.72	1.07
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.90	0.88	1.03	1.25
Particulates		(3)	g/bkW-hr	0.18	0.18	0.21	0.25
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	7262	6539	4942	3471
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	583	539	441	343
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	145	131	99	69
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	299	285	252	218
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	2180	1970	1588	1185
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	1903	1736	1166	706
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	1039	852	429	155

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

10/17/2002 **DM5429 - 05**

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3612 Technical Data - 900 rpm

3612 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4180	3800	2850	1900
GENERATOR POWER		(2)	ekW	4004	3640	2730	1820
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.0%	42.2%	42.3%	40.1%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	40.7%	41.0%	41.0%	38.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	201.7	200.4	200.3	211.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	205.8	204.3	204.2	215.2
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	207.6	206.5	206.7	218.0
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	417.4	383.8	292.6	206.1
AIR MASS FLOW			kg/hr	27937	25686	19585	13792
COMPRESSOR OUTLET PRESSURE			kPa (abs)	315.0	279.3	185.5	100.9
COMPRESSOR OUTLET TEMPERATURE			°C	235.4	217.4	169.5	117.0
INLET MANIFOLD PRESSURE			kPa (abs)	315.5	279.7	185.6	100.9
INLET MANIFOLD TEMPERATURE			°C	56.9	54.0	47.5	44.2
TIMING		(9)	°BTDC	12.5	12.5	12.5	12.5
EXHAUST STACK TEMPERATURE			°C	380.9	374.7	375.2	375.9
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	446.0	405.0	311.0	219.0
EXHAUST GAS MASS FLOW			kg/hr	28800	26468	20169	14197
EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	10.42	10.76	11.52	12.47
CO		(3)	g/bkW-hr	0.92	0.82	0.81	1.14
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.81	0.81	0.95	1.29
Particulates		(3)	g/bkW-hr	0.24	0.24	0.25	0.24
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	10268	9274	6946	4881
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	822	773	650	514
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	205	185	139	98
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	405	383	332	280
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	3155	2857	2206	1648
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	2352	2197	1692	1259
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	1477	1256	756	433

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

8/22/2006 **DM5455 - 02**

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3612 Technical Data - 1000 rpm

3612 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4466	4060	3045	2030
GENERATOR POWER		(2)	ekW	4268	3880	2910	1940
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	40.8%	41.4%	41,5%	39.7%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	39.6%	40.2%	40.2%	38.5%

ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	209.0	205.6	205.2	214.3
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	213.0	209.6	209.1	218.5
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	215.1	211.8	211.6	221.3
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	448.2	422.7	326.9	228.9
AIR MASS FLOW			kg/hr	29999	28294	21879	15321
COMPRESSOR OUTLET PRESSURE			kPa (abs)	281.9	256.9	188.1	113.4
COMPRESSOR OUTLET TEMPERATURE			°C	215.1	197.6	155.9	107.6
INLET MANIFOLD PRESSURE			kPa (abs)	290.7	266.2	184.4	99.4
INLET MANIFOLD TEMPERATURE			°C	45.9	43.9	39.9	36.6
TIMING		(9)	°BTDC	12.0	12.0	12.0	12.0
EXHAUST STACK TEMPERATURE			°C	407.8	384.7	376.7	383.5
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	-	-	-	-
EXHAUST GAS MASS FLOW			kg/hr	30501	28745	22217	15556

EMISSIONS						
NOx (as NO)	(3)	g/bkW-hr	7.96	8.19	8.99	9.36
CO	(3)	g/bkW-hr	1.34	0.95	0.77	1.04
THC (molecular weight of 13.018)	(3)	g/bkW-hr	0.70	0.85	1.01	1.21
Particulates	(3)	g/bkW-hr	0.16	0.17	0.22	0.30

ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	11290	10107	7570	5273
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	856	803	6674	533
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	226	202	151	105
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	420	397	342	287
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	3731	3287	2511	1854
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	2457	2405	1911	1365
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	1598	1359	846	463

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

5/23/2003 **DM5510 - 02**

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3616 Technical Data - 900 rpm

3616 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	175-6670
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5566	5060	3795	2530
GENERATOR POWER		(2)	ekW	5324	4840	3630	2420
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	43.6%	43.6%	43.5%	41.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	42.2%	42.3%	42.2%	39.9%

ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	194.5	194.1	194.9	205.9
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	198.2	197.9	198.7	209.9
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	200.3	200.1	201.2	212.7
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	574.2	530.3	382.2	242.9
AIR MASS FLOW			kg/hr	38434	35490	25580	16255
COMPRESSOR OUTLET PRESSURE			kPa (abs)	318.4	283.1	177.9	80.2
COMPRESSOR OUTLET TEMPERATURE			°C	218.2	199.5	149.2	94.8
INLET MANIFOLD PRESSURE			kPa (abs)	317.6	282.1	176.5	79.0
INLET MANIFOLD TEMPERATURE			°C	47.7	45.2	45.6	44.7
TIMING		(9)	°BTDC	11.0	11.0	11.0	11.0
EXHAUST STACK TEMPERATURE			°C	367.4	359.8	399.3	454.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1195.0	1090.0	835.6	576.4
EXHAUST GAS MASS FLOW			kg/hr	39543	36496	26336	16785

EMISSIONS						
NOx (as NO)	(3)	g/bkW-hr	8.56	9.00	10.83	12.08
CO	(3)	g/bkW-hr	0.92	0.78	0.70	1.20
THC (molecular weight of 13.018)	(3)	g/bkW-hr	0.72	0.73	0.91	1.04
Particulates	(3)	g/bkW-hr	0.18	0.18	0.22	0.29

ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	13174	11959	9001	6338
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	1094	1029	866	684
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	263	239	180	127
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	540	511	442	373
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	3928	3566	2860	2134
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	3136	2964	1956	1168
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	1703	1435	646	198

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

5/22/2003 **DM5431 - 05**

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3616 Technical Data - 1000 rpm

3616 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUX.
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	200-8031
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	200
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	MUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5962	5420	4065	2710
GENERATOR POWER		(2)	ekW	5720	5200	3900	2600
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.3%	42.7%	42.4%	40.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.0%	41.4%	41.1%	39.0%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	199.6	197.8	199.5	210.7
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	203.5	201.7	203.4	214.7
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	205.5	203.9	205.9	217.5
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	649.8	593.8	437.3	280.3
AIR MASS FLOW			kg/hr	43491	39746	29269	18757
COMPRESSOR OUTLET PRESSURE			kPa (abs)	341.3	301.4	195.8	95.3
COMPRESSOR OUTLET TEMPERATURE			°C	219.1	202.2	155.5	100.1
INLET MANIFOLD PRESSURE			kPa (abs)	339.2	299.5	194.2	94.9
INLET MANIFOLD TEMPERATURE			°C	47.4	45.9	42.9	42.8
TIMING		(9)	°BTDC	12.5	12.5	12.5	12.5
EXHAUST STACK TEMPERATURE			°C	351.1	349.5	383.9	432.1
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1317.0	1200.0	933.2	643.5
EXHAUST GAS MASS FLOW			kg/hr	44714	40846	30099	19339
EMISSIONS							
NOx (as NO)		(3)	g/bkW-hr	8.27	8.64	9.71	10.95
CO		(3)	g/bkW-hr	1.00	0.77	0.72	1.07
THC (molecular weight of 13.018)		(3)	g/bkW-hr	0.90	0.88	1.03	1.25
Particulates		(3)	g/bkW-hr	0.18	0.18	0.21	0.25
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	14524	13078	9884	6942
HEAT REJ. TO JACKET WATER	(NOMINAL)	(4)	KW	1166	1079	882	686
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(5)	KW	290	262	198	139
HEAT REJ. TO OIL COOLER	(NOMINAL)	(6)	KW	598	569	503	437
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(4)	KW	4361	3941	3176	2370
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(4)	KW	3807	3472	2333	1413
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(7) (8)	KW	2080	1705	859	310

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) EMISSION DATA SHOWN ARE NOT TO EXCEED VALUES
4) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
7) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
8) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)
9) TIMING BASED ON AFM INJECTORS
10) EMMISSION DATA SHOWN ARE NOMINAL VALUES

10/17/2005 **DM5428 - 05**

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C280-6 Tier 1 Technical Data - 900 rpm - Sheet 1 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2090	1900	1425	950
GENERATOR POWER		(2)	ekW	2002	1820	1365	910
BMEP			kPa	2515	2286	1715	1143
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	43.1%	43.3%	43.0%	41.1%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.8%	42.0%	41.7%	39.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	195.9	195.4	196.8	206.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	199.7	199.2	200.7	210.1
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	201.8	201.4	203.2	212.9
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	193.3	181.2	143.6	102.1
AIR MASS FLOW			kg/hr	12936	12129	9611	6831
INLET MANIFOLD PRESSURE			kPa (abs)	383.6	357.8	278.4	196.0
INLET MANIFOLD TEMPERATURE			°C	43	42.2	41.3	40.1
EXHAUST STACK TEMPERATURE			°C	394.1	382.3	378.2	380.8
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	428.7	394.4	310.2	221.2
EXHAUST GAS MASS FLOW			kg/hr	13356	12510	9898	7031
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	12.14	11.94	11.9	11.83
CO			g/bkW-hr	1.05	0.93	0.62	0.87
THC (molecular weight of 13.018)			g/bkW-hr	0.79	0.8	0.82	1.09
Particulates			g/bkW-hr	0.41	0.28	0.16	0.23
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.55	10.38	10.35	10.29
CO			g/bkW-hr	0.81	0.72	0.48	0.67
THC (molecular weight of 13.018)			g/bkW-hr	0.61	0.62	0.63	0.84
Particulates			g/bkW-hr	0.29	0.2	0.11	0.16
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	4998	4528	3416	2381
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	412	387	326	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	100	91	68	48
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	203	192	166	140
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1521	1378	1084	804
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1065	1020	819	600
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	656	567	340	179

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

4/12/2006 **DM5809 - 02**

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C280-6 Tier 1 Technical Data - 900 rpm - Sheet 2 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M		87.7	84.6	83.8	84.1	85.3	81	77	69
7M		93.7	90.6	89.8	90.1	91.3	87	83	75
1M		104.7	101.6	100.8	101.1	102.3	98	94	86

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	96	106.6	103.7	95.4	90.1	85.7	86.2	84.3	78.9
7M	102	114.4	111.0	101.7	96.9	92.0	93.0	91.6	86.2
1.5M	116	126.9	125.5	115.3	110.5	106.1	107.5	105.1	99.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-6 Tier 1 Technical Data - 1000 rpm - Sheet 1 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	10
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2233	2030	1523	1015
GENERATOR POWER		(2)	ekW	2144	1949	1462	974
BMEP			kPa	2418	2198	1649	1099
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.2%	42.4%	42.0%	39.8%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.0%	41.1%	40.8%	38.7%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	200.5	199.8	201.5	213.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	204.4	203.7	205.4	217.3
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	206.5	205.9	207.9	220.1
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	217.9	204.3	160.1	116.3
AIR MASS FLOW			kg/hr	14586	13674	10717	7786
INLET MANIFOLD PRESSURE			kPa (abs)	371.6	347.8	273.1	199.3
INLET MANIFOLD TEMPERATURE			°C	36.0	36.0	35.0	35.0
EXHAUST STACK TEMPERATURE			°C	391.6	376.3	372.0	371.9
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	481.1	440.2	342.4	248.5
EXHAUST GAS MASS FLOW			kg/hr	15044	14090	11031	8007
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	10.46	10.95	11.91	10.82
CO			g/bkW-hr	0.87	0.66	0.69	0.94
THC (molecular weight of 13.018)			g/bkW-hr	0.84	0.85	1.07	1.41
Particulates			g/bkW-hr	0.16	0.19	0.31	0.89
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	9.10	9.52	10.36	9.40
CO			g/bkW-hr	0.67	0.51	0.53	0.72
THC (molecular weight of 13.018)			g/bkW-hr	0.84	0.65	0.82	1.09
Particulates			g/bkW-hr	0.12	0.14	0.22	0.63
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	5452	4939	3735	2626
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	436	404	330	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	109	99	75	53
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	224	213	189	164
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1694	1530	1198	902
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1200	1167	934	703
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	744	652	413	234

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-6 Tier 1 Technical Data - 1000 rpm - Sheet 2 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M		87.7	84.6	83.8	84.1	85.3	81	77	69
7M		93.7	90.6	89.8	90.1	91.3	87	83	75
1M		104.7	101.6	100.8	101.1	102.3	98	94	86

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	96	107.1	104.6	95.4	91.5	86.7	87.2	85.2	80.9
7M	103	114.4	111.4	102.2	97.9	93.0	94.4	82.8	88.2
1.5M	116	127.4	125.0	114.9	111.4	107.0	108.5	106.1	100.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-8 Tier 1 Technical Data - 900 rpm - Sheet 1 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

Genset	60 Hz		
		RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	258-2292
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2783	2530	1898	1265
GENERATOR POWER		(2)	ekW	2662	2420	1815	1210
BMEP			kPa	2512	2283	1712	1142
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	44.7%	44.9%	44.5%	41.6%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.4%	43.6%	43.1%	40.4%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	189.2	188.4	190.5	203.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	192.9	192.1	194.2	207.1
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	195.0	194.3	196.7	209.9
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	264.2	239.1	173.0	115.4
AIR MASS FLOW			kg/hr	17681	16004	11576	7721
INLET MANIFOLD PRESSURE			kPa (abs)	395.9	358.2	259.8	176.8
INLET MANIFOLD TEMPERATURE			°C	35.6	34.5	33.5	33.0
EXHAUST STACK TEMPERATURE			°C	370.1	361.8	400.9	458.1
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	563.8	503.8	387.4	280.9
EXHAUST GAS MASS FLOW			kg/hr	18221	16492	11946	7984
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	11.63	12.20	13.28	10.54
CO			g/bkW-hr	0.39	0.46	0.52	1.33
THC (molecular weight of 13.018)			g/bkW-hr	0.55	0.58	0.62	0.80
Particulates			g/bkW-hr	0.19	0.23	0.26	0.40
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.11	10.61	11.54	9.17
CO			g/bkW-hr	0.30	0.35	0.40	1.02
THC (molecular weight of 13.018)			g/bkW-hr	0.43	0.44	0.48	0.62
Particulates			g/bkW-hr	0.14	0.16	0.18	0.28
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	6411	5803	4401	3132
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	547	515	433	343
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	128	116	88	63
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	270	255	221	187
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1872	1676	1369	1083
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1474	1378	929	586
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	797	698	382	184

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-8 Tier 1 Technical Data - 900 rpm - Sheet 2 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	92.0	90.7	87.6	86.8	87.1	88.3	84.0	80.0	72.0
7M	97.0	96.2	93.1	92.3	92.6	93.8	89.5	85.5	77.5
1M	108.0	107.2	104.1	103.3	103.6	104.8	100.5	96.5	8.5

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	97.0	107.6	104.7	96.4	91.1	86.7	87.2	85.3	79.9
7M	103.0	115.4	112.0	102.7	97.9	93.0	94.0	92.6	87.2
1.5M	117.0	127.9	126.5	116.3	111.5	107.1	108.5	106.1	100.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-8 Tier 1 Technical Data - 1000 rpm - Sheet 1 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	258-2288
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	10
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2981	2710	2033	1355
GENERATOR POWER		(2)	ekW	2860	2600	1950	1300
BMEP			kPa	2421	2201	1651	1101
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	45.2%	44.7%	43.7%	40.6%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.9%	43.4%	42.4%	39.4%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	187.0	189.1	193.8	208.3
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	190.6	192.8	197.5	212.3
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	192.7	195.0	200.0	215.1
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	305.8	277.8	209.8	141.1
AIR MASS FLOW			kg/hr	20465	18590	14045	9447
INLET MANIFOLD PRESSURE			kPa (abs)	399.7	359.1	271.3	184.5
INLET MANIFOLD TEMPERATURE			°C	44.5	44.4	43.3	43.2
EXHAUST STACK TEMPERATURE			°C	356.9	364.6	398.5	455.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	637.7	586.5	466.9	341.3
EXHAUST GAS MASS FLOW			kg/hr	21036	19117	14449	9736
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	12.07	12.76	11.97	10.15
CO			g/bkW-hr	0.85	0.79	0.68	1.26
THC (molecular weight of 13.018)			g/bkW-hr	1.49	1.06	0.96	1.30
Particulates			g/bkW-hr	0.29	0.25	0.23	0.36
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.50	11.09	10.41	8.83
CO			g/bkW-hr	0.65	0.61	0.52	0.97
THC (molecular weight of 13.018)			g/bkW-hr	1.14	0.81	0.74	1.00
Particulates			g/bkW-hr	0.21	0.18	0.16	0.26
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	6793	6247	4798	3440
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	582	539	440	344
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	136	125	96	69
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	299	285	252	219
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1972	1878	1582	1273
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1666	1522	1085	695
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	805	694	384	172

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-8 Tier 1 Technical Data - 1000 rpm - Sheet 2 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	94.0	93.2	90.1	89.3	89.6	90.8	86.5	82.5	74.5
7M	100.0	98.7	95.6	94.8	95.1	96.3	92.0	88.0	80.0
1M	111.0	109.7	106.6	105.8	106.1	107.3	103.0	99.0	91.0

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	97.0	108.6	105.6	96.0	92.1	87.2	88.2	86.2	80.4
7M	104.0	115.4	112.9	104.2	98.9	94.9	94.9	93.0	88.2
1.5M	117.0	128.9	126.0	116.3	112.4	107.6	108.5	106.6	100.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-12 Tier 1 Technical Data - 900 rpm - Sheet 1 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

Genset	60 Hz		
		RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4180	3800	2850	1900
GENERATOR POWER		(2)	ekW	4004	3640	2730	1820
BMEP			kPa	2515	2286	1715	1143
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	43.1%	43.3%	43.0%	41.1%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.8%	42.0%	41.7%	39.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	195.9	195.4	196.8	206.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	199.7	199.2	200.7	210.1
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	201.8	201.4	203.2	212.9
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	386.6	362.4	287.2	204.1
AIR MASS FLOW			kg/hr	25873	24358	19223	13662
INLET MANIFOLD PRESSURE			kPa (abs)	383.7	357.8	27.4	196.0
INLET MANIFOLD TEMPERATURE			°C	43.0	42.2	41.3	40.1
EXHAUST STACK TEMPERATURE			°C	394.1	382.3	378.2	380.8
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	857.5	788.9	620.4	442.4
EXHAUST GAS MASS FLOW			kg/hr	26713	25020	19798	14062
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	12.14	11.94	11.90	11.83
CO			g/bkW-hr	1.05	0.93	0.62	0.87
THC (molecular weight of 13.018)			g/bkW-hr	0.79	0.80	0.82	1.09
Particulates			g/bkW-hr	0.41	0.28	0.16	0.23
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.56	10.38	10.35	10.29
CO			g/bkW-hr	0.81	0.72	0.48	0.67
THC (molecular weight of 13.018)			g/bkW-hr	0.61	0.62	0.63	0.84
Particulates			g/bkW-hr	0.29	0.20	0.11	0.16
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	9997	9057	6833	4763
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	823	774	651	514
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	200	181	137	95
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	406	384	332	280
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3042	2756	2168	1608
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	2130	2041	1638	1199
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1313	1135	680	358

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-12 Tier 1 Technical Data - 900 rpm - Sheet 2 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	79.2	85.2	84.7	85.3	84.3	82.3	81.0	78.6
7M	-	94.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
1M	-	96.2	102.2	101.7	102.3	101.3	99.3	98.0	95.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	98.0	108.6	105.7	97.4	92.1	87.7	88.2	86.3	80.9
7M	104.0	116.4	113.0	103.7	98.9	94.0	95.0	93.6	88.2
1.5M	118.0	128.9	127.5	117.3	112.5	108.1	109.5	107.1	101.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-12 Tier 1 Technical Data - 1000 rpm - Sheet 1 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	10
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4466	4060	3045	2030
GENERATOR POWER		(2)	ekW	4287	3898	2923	1949
BMEP			kPa	2418	2198	1649	1099
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.2%	42.4%	42.0%	39.8%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.0%	41.1%	40.8%	38.7%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	200.5	199.8	201.5	213.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	204.4	203.7	205.4	217.3
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	206.5	205.9	207.9	220.1
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	435.9	408.6	320.3	232.7
AIR MASS FLOW			kg/hr	29172	27348	21435	15573
INLET MANIFOLD PRESSURE			kPa (abs)	371.7	347.8	273.1	199.3
INLET MANIFOLD TEMPERATURE			°C	36.0	36.0	35.0	35.0
EXHAUST STACK TEMPERATURE			°C	391.6	376.3	372.0	371.9
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	962.3	880.5	684.8	497.0
EXHAUST GAS MASS FLOW			kg/hr	30088	28180	22063	16015
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	10.46	10.95	11.91	10.82
CO			g/bkW-hr	0.88	0.66	0.69	0.94
THC (molecular weight of 13.018)			g/bkW-hr	0.84	0.85	1.07	1.41
Particulates			g/bkW-hr	0.16	0.19	0.31	0.88
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	9.10	9.52	10.36	9.41
CO			g/bkW-hr	0.67	0.51	0.53	0.72
THC (molecular weight of 13.018)			g/bkW-hr	0.65	0.65	0.82	1.09
Particulates			g/bkW-hr	0.12	0.14	0.22	0.63
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	10904	9879	7470	5252
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	859	806	676	533
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	218	198	149	105
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	422	398	342	287
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3408	3076	2405	1815
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	2414	2346	1875	1415
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1507	1319	837	478

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-12 Tier 1 Technical Data - 1000 rpm - Sheet 2 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	79.2	85.2	84.7	85.3	84.3	82.3	81.0	78.6
7M	-	94.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
1M	-	96.2	102.2	101.7	102.3	101.3	99.3	98.0	95.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	98.0	109.1	106.6	97.4	93.5	88.7	89.2	87.2	82.9
7M	105.0	116.4	113.4	104.2	99.9	95.0	96.4	84.8	90.2
1.5M	118.0	129.4	127.0	116.9	113.4	109.0	110.5	108.1	102.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-16 Tier 1 Technical Data - 900 rpm - Sheet 1 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	258-2292
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5566	5060	3795	2530
GENERATOR POWER		(2)	ekW	5324	4840	3630	2420
BMEP			kPa	2512	2283	1712	1142
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	44.7%	44.9%	44.5%	41.6%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.4%	43.6%	43.1%	40.4%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	189.2	188.4	190.5	203.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	192.9	192.1	194.2	207.1
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	195.0	194.3	196.7	209.9
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	528.3	478.2	345.9	230.7
AIR MASS FLOW			kg/hr	35361	32008	23153	15442
INLET MANIFOLD PRESSURE			kPa (abs)	395.9	358.2	259.8	176.8
INLET MANIFOLD TEMPERATURE			°C	35.6	34.5	33.5	33.0
EXHAUST STACK TEMPERATURE			°C	370.1	361.8	400.9	458.1
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1127.7	1007.6	774.8	561.8
EXHAUST GAS MASS FLOW			kg/hr	36441	32984	23893	15969
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	11.63	12.20	13.28	10.54
CO			g/bkW-hr	0.39	0.46	0.52	1.33
THC (molecular weight of 13.018)			g/bkW-hr	0.55	0.58	0.62	0.80
Particulates			g/bkW-hr	0.19	0.23	0.26	0.40
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.11	10.61	11.54	9.17
CO			g/bkW-hr	0.30	0.35	0.40	1.02
THC (molecular weight of 13.018)			g/bkW-hr	0.43	0.44	0.48	0.62
Particulates			g/bkW-hr	0.14	0.16	0.18	0.28
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	12823	11606	8801	6265
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	1094	1029	866	685
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	256	232	176	125
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	540	511	442	373
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3744	3352	2738	2166
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	2948	2757	1859	1171
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1594	1396	764	369

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-16 Tier 1 Technical Data - 900 rpm - Sheet 2 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	94.0	82.2	88.2	87.7	88.3	87.3	85.3	84.0	81.6
7M	98.0	87.7	93.7	93.2	93.8	92.8	90.8	89.5	87.1
1M	109.0	98.7	104.7	104.2	104.8	103.8	101.8	100.5	98.1

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	99.0	109.6	106.7	98.4	93.1	88.7	89.2	87.3	81.9
7M	105.0	117.4	114.0	104.7	99.9	95.0	96.0	94.6	89.2
1.5M	119.0	129.9	128.5	118.3	113.5	109.1	110.5	108.1	102.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-16 Tier 1 Technical Data - 1000 rpm - Sheet 1 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 1
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	258-2288
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	10
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5962	5420	4065	2710
GENERATOR POWER		(2)	ekW	5720	5200	3900	2600
BMEP			kPa	2421	2201	1651	1101
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	45.2%	44.7%	43.7%	40.6%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.9%	43.4%	42.4%	39.4%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	187.0	189.1	193.8	208.3
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	190.6	192.8	197.5	212.3
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	192.7	195.0	200.0	215.1
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	611.5	555.5	419.7	282.3
AIR MASS FLOW			kg/hr	40930	37181	28090	18894
INLET MANIFOLD PRESSURE			kPa (abs)	399.7	359.1	271.3	184.5
INLET MANIFOLD TEMPERATURE			°C	44.5	44.4	43.3	43.2
EXHAUST STACK TEMPERATURE			°C	356.9	364.6	398.5	455.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1275.3	1173.0	933.8	682.7
EXHAUST GAS MASS FLOW			kg/hr	42072	38233	28898	19473
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO)			g/bkW-hr	12.07	12.76	11.97	10.15
CO			g/bkW-hr	0.85	0.79	0.68	1.26
THC (molecular weight of 13.018)			g/bkW-hr	1.49	1.06	0.96	1.30
Particulates			g/bkW-hr	0.29	0.25	0.23	0.36
EMISSIONS "NOMINAL DATA"							
NOx (as NO)			g/bkW-hr	10.50	11.09	10.41	8.83
CO			g/bkW-hr	0.65	0.61	0.52	0.97
THC (molecular weight of 13.018)			g/bkW-hr	1.14	0.81	0.74	1.00
Particulates			g/bkW-hr	0.21	0.18	0.16	0.26
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	13585	12495	9596	6880
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	1164	1079	881	687
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	272	250	192	138
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	598	569	503	437
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3943	3755	3163	2547
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	3331	3043	2171	1390
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1610	1388	768	344

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-16 Tier 1 Technical Data - 1000 rpm - Sheet 2 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	95.0	84.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
7M	101.0	90.2	96.2	95.7	96.3	95.3	93.3	92.0	89.6
1M	112.0	101.2	107.2	106.7	107.3	106.3	104.3	103.0	100.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	99.0	110.6	107.6	98.0	94.1	89.2	90.2	88.2	82.4
7M	106.0	117.4	114.9	106.2	100.9	96.9	96.9	95.0	90.2
1.5M	119.0	130.9	128.0	118.3	114.4	109.6	110.5	108.6	102.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-6 Tier 2 Technical Data - 900 rpm - Sheet 1 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2090	1900	1425	950
GENERATOR POWER		(2)	ekW	2002	1820	1365	910
BMEP			kPa	2515	2286	1715	1143
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.8%	42.6%	40.3%	38.7%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.6%	41.3%	39.1%	37.5%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	197.1	198.5	210.0	219.0
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	200.9	202.3	214.1	223.3
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	203.0	204.5	216.6	226.1
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	193.5	184.8	163.0	117.9
AIR MASS FLOW			kg/hr	12950	12368	10908	7888
INLET MANIFOLD PRESSURE			kPa (abs)	383.5	363.1	323.8	233.6
INLET MANIFOLD TEMPERATURE			°C	43.1	42.7	38.9	37.8
EXHAUST STACK TEMPERATURE			°C	394.0	382.9	374.8	372.2
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	423.5	395.8	341.6	246.3
EXHAUST GAS MASS FLOW			kg/hr	13370	12752	11213	8100
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	13.20	9.65	8.03	8.24
NOx (as NO)			g/bkW-hr	12.39	8.86	7.28	7,21
CO			g/bkW-hr	1.03	0.84	0.75	0.89
THC (molecular weight of 13.018)			g/bkW-hr	0.81	0.78	0.75	1.03
Particulates			g/bkW-hr	0.42	0.32	0.37	0.37
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	11.40	8.31	6.91	7.17
NOx (as NO)			g/bkW-hr	10.78	7.71	6.33	6.27
CO			g/bkW-hr	0.79	0.64	0.58	0.78
THC (molecular weight of 13.018)			g/bkW-hr	0.63	0.60	0.58	0.90
Particulates			g/bkW-hr	0.30	0.23	0.26	0.32
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	5029	4600	3644	2531
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	412	387	326	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	101	92	73	51
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	203	192	166	140
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1536	1418	1197	885
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1076	1047	920	689
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	671	598	450	244

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-6 Tier 2 Technical Data - 900 rpm - Sheet 2 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	87.7	84.6	83.8	84.1	85.3	81.0	77.0	69.0
7M	-	93.7	90.6	89.8	90.1	91.3	87.0	83.0	75.0
1M	-	104.7	101.6	100.8	101.1	102.3	98.0	94.0	86.0

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	96.0	106.6	103.7	95.4	90.1	85.7	86.2	84.3	78.9
7M	102.0	114.4	111.0	101.7	96.9	92.0	93.0	91.6	86.2
1.5M	116.0	126.9	125.5	115.3	110.5	106.1	107.5	105.1	99.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-6 Tier 2 Technical Data - 1000 rpm - Sheet 1 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2233	2030	1523	1015
GENERATOR POWER		(2)	ekW	2144	1949	1462	974
BMEP			kPa	2418	2198	1649	1099
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.0%	42.1%	39.6%	38.6%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	40.8%	40.8%	38.4%	37.4%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	201.5	201.2	213.9	220.1
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	205.4	205.1	218.0	224.4
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	207.5	207.3	220.5	227.2
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	218.0	204.9	178.3	128.5
AIR MASS FLOW			kg/hr	14594	13713	11937	8598
INLET MANIFOLD PRESSURE			kPa (abs)	372.5	349.2	302.0	218.2
INLET MANIFOLD TEMPERATURE			°C	44.0	43.0	40.0	37.0
EXHAUST STACK TEMPERATURE			°C	391.6	376.9	373.4	368.1
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	455.7	425.8	363.9	261.6
EXHAUST GAS MASS FLOW			kg/hr	14601	13720	11942	8602
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	10.90	8.78	9.93	9.50
NOx (as NO)			g/bkW-hr	10.11	7.87	8.84	8.07
CO			g/bkW-hr	0.84	0.56	0.78	1.10
THC (molecular weight of 13.018)			g/bkW-hr	0.78	0.91	1.10	1.43
Particulates			g/bkW-hr	0.16	0.19	0.31	0.89
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	9.40	7.54	8.53	8.11
NOx (as NO)			g/bkW-hr	8.79	6.84	7.68	7.01
CO			g/bkW-hr	0.64	0.43	0.60	0.84
THC (molecular weight of 13.018)			g/bkW-hr	0.60	0.70	0.84	1.10
Particulates			g/bkW-hr	0.12	0.14	0.22	0.63
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	5478	4973	3964	2712
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	436	404	330	257
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	110	99	79	54
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	224	213	189	164
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	1724	1562	1338	959
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1221	1187	1035	763
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	740	653	498	260

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-6 Tier 2 Technical Data - 1000 rpm - Sheet 2 of 2

C280-6 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	87.7	84.6	83.8	84.1	85.3	81.0	77.0	69.0
7M	-	93.7	90.6	89.8	90.1	91.3	87.0	83.0	75.0
1M	-	104.7	101.6	100.8	101.1	102.3	98.0	94.0	86.0

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	96.0	107.1	104.6	95.4	91.5	86.7	87.2	85.2	80.9
7M	103.0	114.4	111.4	102.2	97.9	93.0	94.4	82.8	88.2
1.5M	116.0	127.4	125.0	114.9	111.4	107.0	108.5	106.1	100.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-8 Tier 2 Technical Data - 900 rpm - Sheet 1 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	284-8281
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2783	2530	1898	1265
GENERATOR POWER		(2)	ekW	2662	2420	1815	1210
BMEP			kPa	2512	2283	1712	1142
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.9%	43.5%	41.0%	39.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.6%	42.2%	39.8%	38.0%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	197.3	194.7	206.3	216.0
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	201.2	198.5	210.4	220.2
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	203.2	200.7	212.9	223.0
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	276.3	240.5	203.6	130.6
AIR MASS FLOW			kg/hr	18491	16095	13630	8743
INLET MANIFOLD PRESSURE			kPa (abs)	409.9	360.6	304.7	198.2
INLET MANIFOLD TEMPERATURE			°C	44.3	42.8	38.6	35.9
EXHAUST STACK TEMPERATURE			°C	368.1	361.3	377.8	442.3
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	569.3	512.4	364.4	243.1
EXHAUST GAS MASS FLOW			kg/hr	18239	16510	1195	7993
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	8.34	8.51	9.12	9.01
NOx (as NO)			g/bkW-hr	7.73	7.86	8.37	8.03
CO			g/bkW-hr	0.39	0.46	0.52	1.33
THC (molecular weight of 13.018)			g/bkW-hr	0.61	0.64	0.75	0.98
Particulates			g/bkW-hr	0.19	0.23	0.26	0.40
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	7.19	7.34	7.86	7.74
NOx (as NO)			g/bkW-hr	6.72	6.84	7.28	6.99
CO			g/bkW-hr	0.30	0.35	0.40	1.02
THC (molecular weight of 13.018)			g/bkW-hr	0.47	0.50	0.58	0.75
Particulates			g/bkW-hr	0.14	0.16	0.18	0.28
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	6686	5998	4767	3330
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	547	515	433	343
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	134	120	95	67
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	270	255	221	187
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	2034	1791	1555	1205
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1618	1477	1177	691
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	905	775	554	256

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-8 Tier 2 Technical Data - 900 rpm - Sheet 2 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	92.0	90.7	87.6	86.8	87.1	88.3	84.0	80.0	72.0
7M	97.0	96.2	93.1	92.3	92.6	93.6	89.5	85.5	77.5
1M	108.0	107.2	104.1	103.3	103.6	104.8	100.5	96.5	88.5

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	97.0	107.6	104.7	96.4	91.1	86.7	87.2	85.3	79.9
7M	103.0	115.4	112.0	102.7	97.9	93.0	94.0	92.6	87.2
1.5M	117.0	127.9	126.5	116.3	111.5	107.1	108.5	106.1	100.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-8 Tier 2 Technical Data - 1000 rpm - Sheet 1 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	284-8277
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	2981	2710	2033	1355
GENERATOR POWER		(2)	ekW	2860	2600	1950	1300
BMEP			kPa	2421	2201	1651	1101
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.7%	42.4%	39.5%	39.3%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.5%	41.1%	38.3%	38.1%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	197.9	199.5	214.4	215.3
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	201.7	203.4	218.5	219.5
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	203.8	205.6	221.0	222.3
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	332.3	306.4	260.5	154.1
AIR MASS FLOW			kg/hr	22241	20505	17432	10311
INLET MANIFOLD PRESSURE			kPa (abs)	434.7	398.1	336.0	199.3
INLET MANIFOLD TEMPERATURE			°C	46.3	45.5	43.7	42.2
EXHAUST STACK TEMPERATURE			°C	360.2	357.2	369.9	443.9
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	713.0	653.5	544.7	322.6
EXHAUST GAS MASS FLOW			kg/hr	22843	21057	17877	10608
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	10.72	9.06	8.20	7.90
NOx (as NO)			g/bkW-hr	9.19	7.98	7.19	6.53
CO			g/bkW-hr	0.85	0.79	0.68	1.26
THC (molecular weight of 13.018)			g/bkW-hr	1.53	1.06	1.01	1.37
Particulates			g/bkW-hr	0.31	0.28	0.24	0.44
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	9.17	7.77	7.03	6.73
NOx (as NO)			g/bkW-hr	7.99	6.94	6.25	5.68
CO			g/bkW-hr	0.65	0.61	0.52	0.97
THC (molecular weight of 13.018)			g/bkW-hr	1.17	0.83	0.78	1.05
Particulates			g/bkW-hr	0.22	0.20	0.17	0.31
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	7189	6591	5308	3556
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	582	539	440	344
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	144	132	106	71
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	299	285	252	219
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	2181	2043	1825	1347
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	1809	1723	1438	767
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	984	866	641	212

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

1/19/2007 **DM8401-00**

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C280-8 Tier 2 Technical Data - 1000 rpm - Sheet 2 of 2

C280-8 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	94.0	93.2	90.1	89.3	89.6	90.8	86.5	82.5	74.5
7M	100.0	98.7	95.6	94.8	95.1	96.3	92.0	88.0	80.0
1M	111.0	109.7	106.6	105.8	106.1	107.3	103.0	99.0	91.0

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	97.0	108.6	105.6	96.0	92.1	87.2	88.2	86.2	80.4
7M	104.0	115.4	112.9	104.2	98.9	94.9	94.9	93.0	88.2
1.5M	117.0	128.9	126.0	116.3	112.4	107.6	108.5	106.6	100.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-12 Tier 2 Technical Data - 900 rpm - Sheet 1 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	157-5514
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4180	3800	2850	1900
GENERATOR POWER		(2)	ekW	4004	3640	2730	1820
BMEP			kPa	2515	2286	1715	1143
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	43.1%	42.7%	41.1%	39.8%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	41.8%	41.4%	39.8%	38.6%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	195.8	198.0	206.2	212.8
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	199.6	201.9	210.2	217.0
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	201.7	204.1	212.7	219.8
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	374.7	363.6	320.6	232.7
AIR MASS FLOW			kg/hr	25080	24336	21460	15572
INLET MANIFOLD PRESSURE			kPa (abs)	374.2	356.2	318.8	233.7
INLET MANIFOLD TEMPERATURE			°C	41.7	42.5	39.0	36.4
EXHAUST STACK TEMPERATURE			°C	383.4	374.4	365.8	371.4
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	779.9	745.7	650.9	492.7
EXHAUST GAS MASS FLOW			kg/hr	24612	24027	21363	15603
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	13.49	10.75	10.21	10.23
NOx (as NO)			g/bkW-hr	12.65	9.93	9.41	9.10
CO			g/bkW-hr	0.90	0.96	0.75	0.92
THC (molecular weight of 13.018)			g/bkW-hr	0.84	0.82	0.80	1.13
Particulates			g/bkW-hr	0.41	0.28	0.34	0.56
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	11.65	9.27	8.80	8.78
NOx (as NO)			g/bkW-hr	11.00	8.64	8.18	7.91
CO			g/bkW-hr	0.69	0.74	0.58	0.71
THC (molecular weight of 13.018)			g/bkW-hr	0.65	0.63	0.62	0.87
Particulates			g/bkW-hr	0.29	0.20	0.24	0.40
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	9995	9180	7157	4919
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	823	774	651	514
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	200	184	143	98
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	406	384	332	280
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	2983	2761	2096	1457
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	2197	2126	1687	1139
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1371	1251	1069	662

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-12 Tier 2 Technical Data - 900 rpm - Sheet 2 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	79.2	85.2	84.7	85.3	84.3	82.3	81.0	78.6
7M	-	94.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
1M	-	96.2	102.2	101.7	102.3	101.3	99.3	98.0	95.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	98.0	108.6	105.7	97.4	92.1	87.7	88.2	86.3	80.9
7M	104.0	116.4	113.0	103.7	98.9	94.0	95.0	93.6	88.2
1.5M	118.0	128.9	127.5	117.3	112.5	108.1	109.5	107.1	101.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-12 Tier 2 Technical Data - 1000 rpm - Sheet 1 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	189-4427
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	4466	4060	3045	2030
GENERATOR POWER		(2)	ekW	4287	3898	2923	1949
BMEP			kPa	2418	2198	1649	1099
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	42.0%	42.1%	41.1%	38.8%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	40.8%	40.9%	39.8%	37.6%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	201.5	201.0	206.3	218.9
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	205.4	204.9	210.3	223.1
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	207.5	207.1	212.8	225.9
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	436.1	409.4	335.1	253.5
AIR MASS FLOW			kg/hr	29188	27399	22429	16966
INLET MANIFOLD PRESSURE			kPa (abs)	372.5	348.9	284.6	215.7
INLET MANIFOLD TEMPERATURE			°C	46.0	45.0	40.0	37.0
EXHAUST STACK TEMPERATURE			°C	391.6	376.7	373.0	368.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	939.7	876.2	702.9	529.8
EXHAUST GAS MASS FLOW			kg/hr	30106	28231	23069	17419
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	9.88	10.22	11.28	12.00
NOx (as NO)			g/bkW-hr	9.06	9.30	10.18	10.49
CO			g/bkW-hr	0.98	0.66	0.75	1.13
THC (molecular weight of 13.018)			g/bkW-hr	0.82	0.92	1.10	1.52
Particulates			g/bkW-hr	0.18	0.21	0.34	0.92
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	8.51	8.80	9.70	10.29
NOx (as NO)			g/bkW-hr	7.88	8.09	8.85	9.12
CO			g/bkW-hr	0.75	0.51	0.58	0.87
THC (molecular weight of 13.018)			g/bkW-hr	0.63	0.71	0.64	1.17
Particulates			g/bkW-hr	0.13	0.15	0.24	0.66
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	10957	9938	7646	5393
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	859	806	676	533
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	219	199	153	108
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	422	398	342	287
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3475	3142	2523	1910
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	2461	2392	1957	1515
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1492	1312	891	520

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-12 Tier 2 Technical Data - 1000 rpm - Sheet 2 of 2

C280-12 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	-	79.2	85.2	84.7	85.3	84.3	82.3	81.0	78.6
7M	-	94.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
1M	-	96.2	102.2	101.7	102.3	101.3	99.3	98.0	95.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	98.0	109.1	106.6	97.4	93.5	88.7	89.2	87.2	82.9
7M	105.0	116.4	113.4	104.2	99.9	95.0	96.4	84.8	90.2
1.5M	118.0	129.4	127.0	116.9	113.4	109.0	110.5	108.1	102.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-16 Tier 2 Technical Data - 900 rpm - Sheet 1 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

Genset	**60 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	900	TURBOCHARGER PART #:	284-8281
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5566	5060	3795	2530
GENERATOR POWER		(2)	ekW	5324	4840	3630	2420
BMEP			kPa	252	2283	1712	1142
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	44.6%	44.1%	42.9%	41.2%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.3%	42.8%	41.6%	39.9%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	189.8	192.0	197.5	205.5
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	193.5	195.8	201.4	209.5
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	195.6	198.0	203.9	212.3
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	517.4	477.8	369.5	235.5
AIR MASS FLOW			kg/hr	34629	31982	24728	15764
INLET MANIFOLD PRESSURE			kPa (abs)	390.5	358.6	278.0	180.6
INLET MANIFOLD TEMPERATURE			°C	48.6	44.9	38.0	36.0
EXHAUST STACK TEMPERATURE			°C	368.7	362.1	393.4	452.7
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1113.9	1022.9	776.7	495.6
EXHAUST GAS MASS FLOW			kg/hr	35690	32957	25492	16295
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	12.06	9.54	10.50	10.42
NOx (as NO)			g/bkW-hr	11.45	8.95	9.87	9.56
CO			g/bkW-hr	0.39	0.46	0.52	1.33
THC (molecular weight of 13.018)			g/bkW-hr	0.61	0.59	0.63	0.85
Particulates			g/bkW-hr	0.15	0.20	0.28	0.43
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	10.42	8.24	9.06	8.97
NOx (as NO)			g/bkW-hr	9.95	7.78	8.58	8.31
CO			g/bkW-hr	0.30	0.35	0.40	1.02
THC (molecular weight of 13.018)			g/bkW-hr	0.47	0.46	0.48	0.66
Particulates			g/bkW-hr	0.11	0.17	0.20	0.31
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	12863	11830	9127	6337
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	1094	1029	866	685
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	257	237	183	127
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	540	511	442	373
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	3815	3511	2919	2207
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	3024	2883	2051	1216
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1562	1457	902	400

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-16 Tier 2 Technical Data - 900 rpm - Sheet 2 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	94.0	82.2	88.2	87.7	88.3	87.3	85.3	84.0	81.6
7M	98.0	87.7	93.7	93.2	93.8	92.8	90.8	89.5	87.1
1M	109.0	98.7	104.7	104.2	104.8	103.8	101.8	100.5	98.1

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	99.0	109.6	106.7	98.4	93.1	88.7	89.2	87.3	81.9
7M	105.0	117.4	114.0	104.7	99.9	95.0	96.0	94.6	89.2
1.5M	119.0	129.9	128.5	118.3	113.5	109.1	110.5	108.1	102.3

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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C280-16 Tier 2 Technical Data - 1000 rpm - Sheet 1 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

Genset	**50 Hz**	RATING:	MARINE AUXILIARY
		CERTIFICATION:	IMO/EPA MARINE TIER 2
ENGINE SPEED (rpm):	1000	TURBOCHARGER PART #:	284-8277
COMPRESSION RATIO:	13:1	FUEL TYPE:	DISTILLATE
AFTERCOOLER WATER (°C):	32	RATED ALTITUDE @ 25° C:	150
JACKET WATER OUTLET (°C):	90	ASSUMED GENERATOR EFFICIENCY (%):	96
IGNITION SYSTEM:	EUI	ASSUMED GENERATOR POWER FACTOR:	0.8
EXHAUST MANIFOLD:	DRY	MEAN PISTON SPEED (m/s):	9
FIRING PRESSURE, MAXIMUM (kPa):	17300		

RATING		NOTES	LOAD	110%	100%	75%	50%
ENGINE POWER		(2)	bkW	5962	5420	4065	2710
GENERATOR POWER		(2)	ekW	5720	5200	3900	2600
BMEP			kPa	2421	2201	1651	1101
ENGINE EFFICIENCY	(ISO 3046/1)	(1)	%	44.7%	44.1%	41.6%	39.4%
ENGINE EFFICIENCY	(NOMINAL)	(1)	%	43.4%	42.8%	40.3%	38.2%
ENGINE DATA							
FUEL CONSUMPTION	(ISO 3046/1)	(1)	g/bkw-hr	189.0	191.6	203.5	214.8
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	192.7	195.3	207.5	219.0
FUEL CONSUMPTION	(90% CONFIDENCE)	(1)	g/bkw-hr	194.8	197.5	210.0	221.7
AIR FLOW (@25°C, 101.3 kPaa)			Nm3/min	620.5	566.2	470.2	306.3
AIR MASS FLOW			kg/hr	41530	37895	31472	20497
INLET MANIFOLD PRESSURE			kPa (abs)	405.0	365.3	303.3	198.2
INLET MANIFOLD TEMPERATURE			°C	44.6	44.2	43.3	42.2
EXHAUST STACK TEMPERATURE			°C	356.5	362.5	382.0	444.6
EXHAUST GAS FLOW (@ Stack temp, 101.3 kPa)			m3/min	1332.1	1209.0	984.6	641.4
EXHAUST GAS MASS FLOW			kg/hr	42680	38954	32316	21091
EMISSIONS "NOT TO EXCEED DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	11.03	11.66	10.47	9.57
NOx (as NO)			g/bkW-hr	9.56	10.55	9.46	8.26
CO			g/bkW-hr	0.85	0.79	0.68	1.26
THC (molecular weight of 13.018)			g/bkW-hr	1.47	1.11	1.01	1.31
Particulates			g/bkW-hr	0.31	0.28	0.25	0.39
EMISSIONS "NOMINAL DATA"							
NOx (as NO) + THC (molecular weight of 13.018)			g/bkW-hr	9.44	10.03	9.00	8.19
NOx (as NO)			g/bkW-hr	8.31	9.18	8.22	7.18
CO			g/bkW-hr	0.65	0.61	0.52	0.97
THC (molecular weight of 13.018)			g/bkW-hr	1.13	0.86	0.78	1.01
Particulates			g/bkW-hr	0.22	0.20	0.18	0.28
ENERGY BALANCE DATA							
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	13736	12659	10079	7096
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	1164	1079	881	687
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	275	253	202	142
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	598	569	503	437
HEAT REJ. TO EXH. (LHV TO 25° C)	(NOMINAL)	(3)	KW	4020	3833	3394	2683
HEAT REJ. TO EXH. (LHV TO 177° C)	(NOMINAL)	(3)	KW	3405	3140	2516	1524
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	1681	1472	1011	419

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 kPa, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE
PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER.

NOTES

1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, +5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA
3) HEAT REJECTION TO JACKET WATER AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT X ACHRF (heat rate based on treated water)

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C280-16 Tier 2 Technical Data - 1000 rpm - Sheet 2 of 2

C280-16 DIESEL ENGINE TECHNICAL DATA

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.94	0.91	0.88	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67	0.65
45	0.95	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66
40	0.97	0.94	0.91	0.89	0.86	0.83	0.81	0.78	0.76	0.74	0.71	0.69	0.67
35	0.98	0.96	0.93	0.90	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68
30	1.00	0.97	0.94	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69
25	1.00	0.99	0.96	0.93	0.90	0.88	0.85	0.82	0.80	0.77	0.75	0.73	0.70
20	1.00	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.72
15	1.00	1.00	0.99	0.96	0.93	0.91	0.88	0.85	0.83	0.80	0.78	0.75	0.73
10	1.00	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.82	0.79	0.77	0.74

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.23	1.27	1.30	1.34	1.38	1.42	1.45	1.49	1.53	1.56	1.60	1.64	1.67
45	1.18	1.22	1.25	1.29	1.32	1.36	1.39	1.43	1.46	1.50	1.53	1.57	1.61
40	1.13	1.12	1.20	1.23	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.54
35	1.08	1.12	1.15	1.18	1.21	1.24	1.28	1.31	1.34	1.37	1.41	1.44	1.47
30	1.03	1.06	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.40
25	1.00	1.01	1.04	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34
20	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.19	1.21	1.24	1.27
15	1.00	1.00	1.00	1.00	1.00	1.02	1.04	1.07	1.10	1.12	1.15	1.18	1.20
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.04	1.06	1.09	1.11	1.14

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	95.0	84.7	90.7	90.2	90.8	89.8	87.8	86.5	84.1
7M	101.0	90.2	96.2	95.7	96.3	95.3	93.3	92.0	89.6
1M	112.0	101.2	107.2	106.7	107.3	106.3	104.3	103.0	100.6

OCTAVE BAND (Hz)

FREE FIELD EXHAUST NOISE

SOUND PRESSURE LEVEL dB(A)

DISTANCE FROM ENGINE (M)	OVERALL	63	125	250	500	1000	2000	4000	8000
15M	99.0	110.6	107.6	98.0	94.1	89.2	90.2	88.2	82.4
7M	106.0	117.4	114.9	106.2	100.9	96.9	96.9	95.0	90.2
1.5M	119.0	130.9	128.0	118.3	114.4	109.6	110.5	108.6	102.8

OCTAVE BAND (Hz)

TOTAL DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information to help determine actual engine power for your site. The total deration factor includes deration due to altitude and ambient temperature, and air inlet manifold temperature deration.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 25° C and 150 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbo charger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the dtandard aftercooler heat rejection.

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power= engine power x 0.96]. If the actual generator is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BFSC values must be increased by a factor. The factor is a percentage = 96% - actual generator efficiency.

SOUND DATA

Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3.

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Lubrication Oil System

General

The lube system is designed to provide a constant supply of filtered oil at 430 kPa pressure under all engine operating conditions. The major feature of the C280/3600 lube system is the priority valve, shown in **Figure 1**, to regulate the oil pressure at the cylinder block main oil gallery rather than at the oil pump. The oil gallery pressure thus becomes independent of the oil filter and oil cooler pressure drops.

Internal Lubrication System

Oil Coolers

The engines are equipped with a two element lube oil cooler, with the water flow arranged in series. A three element lube oil cooler is available on vee engines to ensure proper cooling in high ambient conditions.

Thermostats

Four thermostats in the lube system control the oil inlet temperature to 85°C (185°F).

Oil Filters

The oil pan is equipped with a 650-micron suction screen. The duplex final 20-micron lube oil filters can be changed while the engine is operating. The normal procedure specifies the filters to be changed at 100 kPa (14.5 psi) pressure drop across the filters.

Centrifugal Bypass Filters

Engine mounted centrifugal bypass oil filters are installed as standard. The filters receive 3 to 4 percent of the oil pump flow and remove solid, micron size particles and can extend the oil filter change periods. The centrifugal filters each have a dirt capacity of 3.6 kg (8 lb.). Typical cleaning intervals are outlined in the Maintenance Interval Schedule section of this guide and discussed in detail in the Caterpillar Operation & Maintenance Manual. An additional shipped loose lube oil centrifuge, customer mounted off-package, can be provided to circulate the oil sump in order to extend the oil life.

Oil Pumps

The oil pumps provide more than the required engine oil flow at rated conditions. This allows high oil pressure early in the operating speed range and provides flow margin.

Lube Oil Heaters

The Caterpillar lube oil heating system is a package mounted unit that is used in combination with a jacket water heater. The typical package includes:

- Circulating pump
- Electric oil heater (9 kW for In-line engines and 11 kW for Vee engines)
- Control panel, including pump control and temperature control, etc.

Lube oil heaters may be necessary when ambient temperatures are below 10°C (50°F) or when quick start capability is required. In some applications, jacket water heaters in conjunction with continuous prelubrication may satisfy lube oil heating requirements; however, this method of heating should be carefully considered before ordering.

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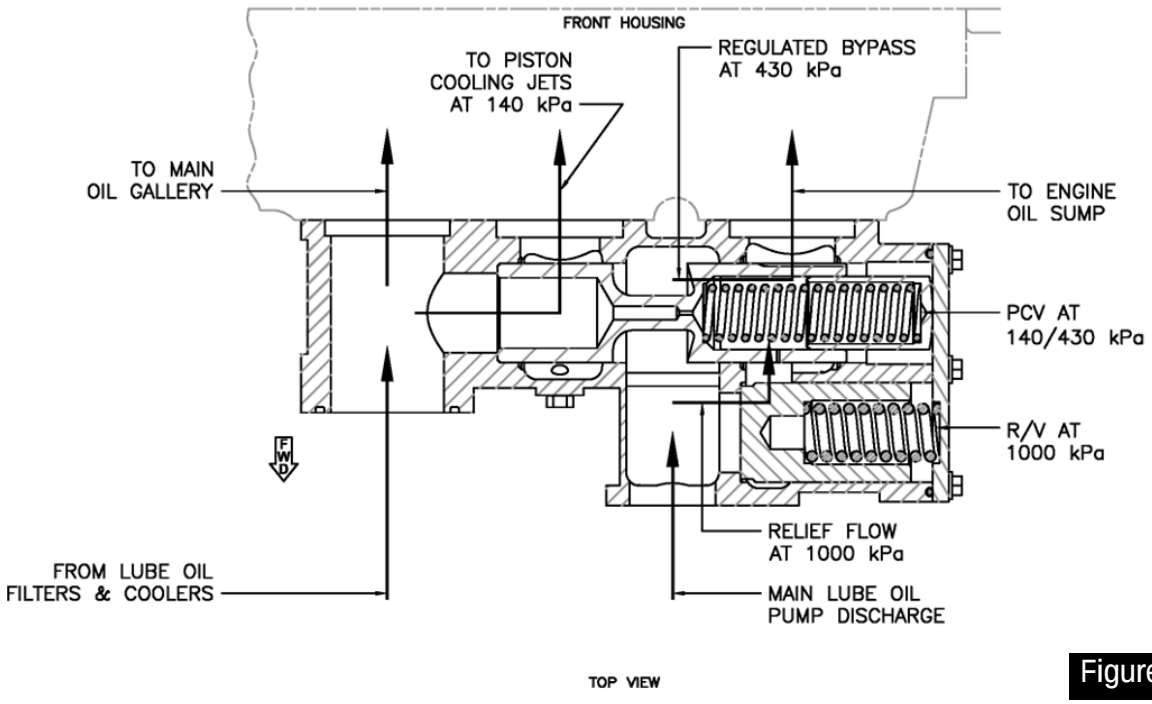
FRONT HOUSING
TO PISTON COOLING JETS AT 140 kPa
REGULATED BYPASS AT 430 kPa
TO MAIN OIL GALLERY
TO ENGINE OIL SUMP
PCV AT 140/430 kPa
R/V AT 1000 kPa
FWD
RELIEF FLOW AT 1000 kPa
FROM LUBE OIL FILTERS & COOLERS
MAIN LUBE OIL PUMP DISCHARGE
TOP VIEW

Figure 1

Prelubrication

Prelubrication is required for C280/3600 series engines and several types of automatic prelubrication systems are available from Caterpillar. These automatic prelubrication systems include starting controls, electric or air powered pumps, a check valve and engine piping. The prelube pumps, whether electric or air powered, must be powered from a source independent of any single failure that could prohibit the engine from starting. A check valve is used to prevent pressurized oil from flowing through the prelube pump during engine operation.

Automatic prelubrication systems available for Caterpillar C280/3600 diesel engines are:

- Redundant Prelube System (recommended system)
- Intermittent Prelube System
- Continuous Prelube System

Redundant Prelube System (recommended system)

The redundant prelube system combines electric continuous and pneumatic intermittent prelube systems, offering the benefits of both. Under normal circumstances, the electric continuous prelube pump keeps the engine ready for immediate start-up, but if the electric continuous pump should fail, the pneumatic intermittent prelube pump will operate. This system is typically selected for dynamic positioning rig applications (DP2 and DP3), when it is critical that an engine is able to start.

Intermittent Prelube System

The pneumatic intermittent prelube system uses an engine mounted pump that is engaged immediately prior to engine start-up, providing suitable performance for applications not requiring quick start capability.

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Continuous Prelube System

The electric continuous prelube system eliminates the delay of waiting for the completion of the intermittent prelube cycle. This system is for immediate starting applications and is typically used in conjunction with jacket water and lube oil heating systems.

Postlubrication

C280/3600 diesel engines have a standard postlubrication cycle of 60 seconds that maintains the oil flow after engine shutdown to protect the turbocharger bearings. However, an engine will not postlube if the Emergency Stop (E-Stop) button is depressed to shutdown the engine. Since an oil leak could potentially require the use of the E-Stop button, the postlube is disabled to stop the flow to a possible leak. Since no postlube occurs with the use of the E-Stop button, it should be used for emergency shutdowns only.

Generator Bearing Lube Oil System

The large generators packaged with C280/3600 Series Offshore Generator Set packages will typically require a forced bearing lubrication system, which typically utilizes a mechanical generator-driven pump to supply lubrication to both front and rear generator bearings.

Caterpillar supplies a Generator Lubrication Module (GLM) for Kato Generators to provide for prelubrication of the generator bearings prior to start-up and to operate in the event of the mechanical pump failure. The GLM is a prepackaged unit that is typically base mounted, but can be remote mounted to suit site specific application requirements. The typical GLM package includes:

- Oil tank
- Electric motor driven oil pump
- Air operated oil pump
- Oil cooler
- Oil filter
- Flow divider to split oil flow to bearings
- Piping, valves and fittings on package

The redundant GLM air prelube pump is available for black start conditions and will operate in parallel with the engine air prelube pump.

For generators supplied by others, the generator manufacturer is responsible for providing any forced lubrication system that may be required to meet tilt requirements.

Oil Requirements

Due to significant variations in the quality and performance of commercially available lubrication oils, Caterpillar recommends the oils listed in the following table for C280/3600 Series Engines that use distillate diesel fuel.

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CAT DEO (Diesel Engine Oil) for C280/3600 Series Diesel Engines Operating on Distillate Diesel Fuel				
Caterpillar Oil	SAE Viscosity Grade	TBN	Ambient Temperature	
			Minimum	Maximum
DEO	SAE 30	13.0	0°C (32°F)	40°C (104°F)
	SAE 40	13.0	5°C (41°F)	50°C (122°F)
DEO Multigrade	SAE 15W-40	11.3	-15°C (5°F)	50°C (122°F)

Lubricant Viscosity

The primary recommendation for the C280/3600 family of engines is an SAE 40-grade oil. SAE 30 and some multigrade oils may be used if the application requires. SAE 30 is preferable to a multigrade oil.

Total Base Number (TBN)

C280/3600 engines operating on distillate fuel require a TBN of 10 times the sulfur level measured in percent of weight. (Example: For a sulfur content of 1% weight, the TBN would be 10.) The minimum TBN level regardless of the sulfur content is 5. Excessively high TBN or high ash oils should not be used in C280/3600 Series engines on distillate fuel, as these oils may lead to excessive piston deposits and loss of oil control. Successful operation of C280/3600 series engines has generally been obtained with new TBN levels between 10 and 15.

Use of Commercial Oil

Caterpillar does not recommend the names of other commercial brands of lube oils, but has established guidelines for their use. Commercially available lubrication oils may be used in Caterpillar C280/3600 Series Diesel Engines, but they **must** have proof of performance in Caterpillar's Field Performance Evaluation, included in Caterpillar document SEBU7003, 3600 Series and C280 Series Diesel Engine Fluids Recommendations.

Oil Change Interval

To achieve maximum life from the engine oil and provide optimum protection for the internal engine components, a Scheduled Oil Sampling program (S•O•S) should be used. This program is available through the Caterpillar dealer network. If an S•O•S analysis program is not available, the oil change interval is recommended in accordance with the following table.

Oil Change Intervals for C280/3600 Series Diesel Engines Operating on Distillate Diesel Fuel		
Engine Model	Lube Oil Capacity	Oil Change Interval
C280-6/3606	880 L (229 US gal)	1400 Service Hours
C280-8/3608	1112 L (289 US gal)	1350 Service Hours
C280-12/3612	1302 L (339 US gal)	1000 Service Hours
C280-16/3616	1677 L (443 US gal)	1000 Service Hours

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Scheduled Oil Sampling

TBN, viscosity and oil consumption trends must be analyzed every 250 hours. The S•O•S analysis involves a two-part test program:

A) Wear Analysis

The Wear Analysis identifies engine wear elements present in the oil. These elements indicate the condition of the engine.

B) Oil Condition Analysis.

The Oil Condition Analysis identifies the wear status of the oil. The program will determine oil change intervals based on trend analysis and condemning limits established for the engine.

Increasing Oil Change Intervals

Oil change intervals can only be increased when the S•O•S analysis indicates that the condemning limits have not been reached, and only when trend lines indicate a stable constant slope. Oil change intervals should only be increased in 250-hour increments, especially in situations where the turn-around time for the oil analysis is long.

Change Interval without Oil Analysis Results

If S•O•S analysis results are not available, the initial oil change interval should be used to determine oil change intervals. Even though oil sampling results may not be available on the recommended 250 hour intervals, oil samples should be analyzed at every oil change period, even if the turn around time for the data is long.

Inclination Capability

For offshore applications with tilt requirements, the Offshore Generator Sets packaged by Caterpillar utilize a shallow dry sump mounted on the engine, which gravity drains into a wet sump that is integral to the base assembly. This design allows for a reduced engine room footprint, eliminates the need for a second lube oil pump and provides 15° static and 25° dynamic tilt capability.

Customer Piping Connections

Engine Connections

Oil Fill and Drain – 38 mm (1-1/2 in. 150# ANSI Flange)

Package Connections

Lube Oil Centrifuge – Inlet and Outlet Connections – 38 mm (1-1/2 in. 150# ANSI Flange)

Lube Oil System Schematic

Engine internal and typical external lube oil systems are illustrated on the schematic shown on the following page.

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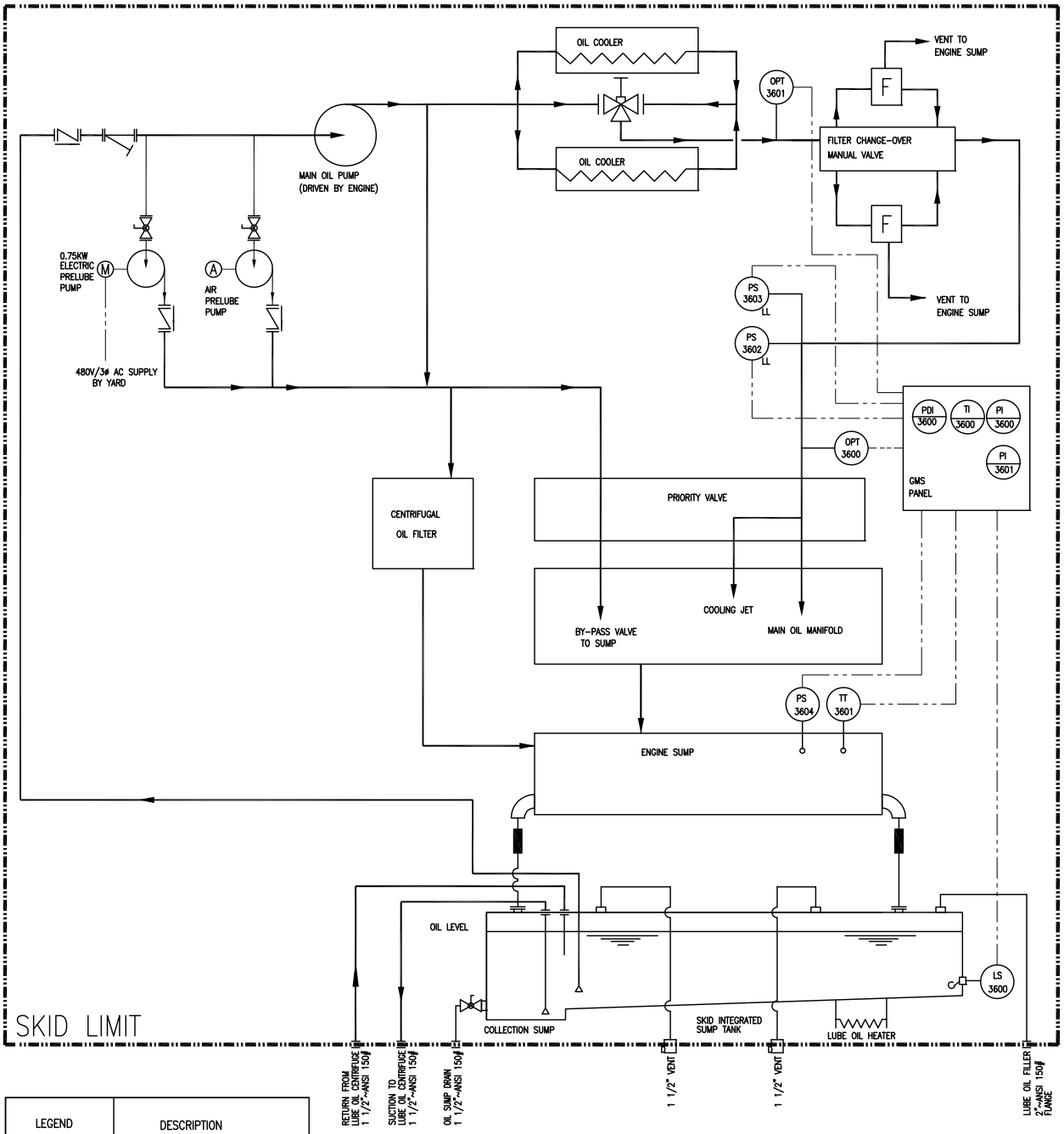

LEGEND	DESCRIPTION
F	DUPLEX OIL FILTER
	PUMP
	CHECK VALVE
	STRAINER
	OIL TEMP.REGULATOR
	BALL VALVE (NORMALLY OPEN)
	BALL VALVE (NORMALLY CLOSED)
	FLEXIBLE HOSE
	PROCESS LINE
	SKID LIMIT

TAG.NO.	DESCRIPTION
PDI 3600	ENGINE OIL DIFFERENTIAL PRESSURE READOUT
PI 3600	LUBE OIL TO FILTER PRESSURE READOUT
PI 3601	LUBE OIL TO ENGINE PRESSURE READOUT
PS 3602	LUBE OIL LOW PRESSURE SWITCH AT LOW SPEED (SHUTDOWN)
PS 3603	LUBE OIL LOW PRESSURE SWITCH AT HIGH SPEED (SHUTDOWN)
PS 3604	CRANKCASE PRESSURE SWITCH
OPT 3600	ENGINE OIL PRESSURE TO ENGINE TRANSMITTER
OPT 3601	ENGINE OIL PRESSURE TO FILTER TRANSMITTER
TI 3600	ENGINE OIL TEMPERATURE READOUT
TT 3601	ENGINE OIL TEMPERATURE TRANSMITTER
LS 3600	ENGINE LOW OIL LEVEL SWITCH

	1E2733	DRAWING – AUTOCAD
	1E0013Y	CONFIDENTIALITY
NOTE	1E0011	INTPR & TOL
	Caterpillar: Confidential Yellow	
CUSTOM PROD.	X	ENGINE MODEL: C280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		SCALE 1 = 20 (0 10mm 20 30)
THIRD ANGLE PROJECTION		SHEET 4 OF 5
		DWG CONTROL W118

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CUSTOMER: MARKETING GUIDE			
END USER:			
PROJECT: C280			
TITLE: P&ID–LUBRICATION SYSTEM			
309–4954	VER –	CHG 00	D

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Crankcase Ventilation System

Crankcase Emissions

Crankcase emissions result from combustion byproducts and/or exhaust fumes escaping around the piston rings and into the crankcase, commonly called blow-by. If not controlled, this blow-by can contaminate the lube oil and pressurize the crankcase, possibly leading to an oil leak.

Venting the emissions to the atmosphere is a simple solution to release the pressure and trapped fumes. Managing the emissions, however, adds complexity to crankcase ventilation systems.

Vent tubes and crankcase breathers are currently provided on the C280/3600 diesel engine and integral oil sump to allow this gas to escape. However, as emission laws become more stringent, it is inevitable that crankcase emissions will be included in total system emission values. In the future, ventilating crankcase emissions to the atmosphere will be discouraged or prohibited.

Current C280/3600 diesel engines still require that crankcase fumes be vented to atmosphere. A closed-loop, on-engine crankcase filtration system (ingestive system) for the C280/3600 series diesel engine is available when requested during the pre-sale phase of the project.

Crankcase Fumes Disposal

Do not vent crankcase and integral oil sump fumes into the engine room. The oily fumes will have a tendency to clog air filters.

Crankcase fumes should be discharged directly to the atmosphere through a venting system individual for each engine.

The engine has breathers located on each cylinder bank on the engine. Crankcase fumes vent pipes must be of sufficient size to prevent the build up of excessive backpressure in the crankcase. Blow-by on a new engine will be approximately 0.02 m^3/hr-bkW (0.5 ft^3/hr bhp). The pipes should be adequately sized to accommodate a worn engine. Size vent piping for 0.04 m^3/hr-bkW (1.0 ft^3/hr bhp) with a maximum of 13 mm H_2O (0.5 in. H_2O) pressure drop in the piping. Formulas for calculating backpressure can be found in the Crankcase Ventilation section of the current Application and Installation Guide.

Loops or low points in a crankcase vent pipe must be avoided to prevent liquid locks from the condensation in the pipe and thus restricting the discharge of fumes. Where horizontal runs are required, install the pipe with a gradual rise of 41.7 mm/m, (0.5 in/ft), slope from the engine. The weight of the vent pipes will require separate off-engine supports as part of the installation design. Further additional flexible connections will need to be installed to accommodate the engine movement.

The pipe should vent directly into the atmosphere at a well-considered location and be fitted with a gooseneck or similar arrangement to keep rain or water spray from entering the engine. Consideration should also be given to other equipment located near the discharge area. If not located properly, the oil carryover can accumulate over time and become unsightly.

An oil condensate trap, as shown on the following drawing, will minimize the amount of oil discharged from the vent pipe.

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The crankcase pressure should not vary more than 25.4 mm H_2O (1.0 in. H_2O) of water from ambient barometric pressure. Measurement should be made at the engine dipstick location with the engine at operating temperature and minimum at 80 to 90 percent of rated load.

Customer Piping Connections

Rubber boot for 60.3 mm (2.375 in.) O.D. Tubing. In-line engines require 1 boot and vee engines require 2.

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Fuel System

General

The fuel system utilizes unit injectors to deliver the correct amount of fuel to the cylinder at the precise moment it is needed, enabling the C280/3600 diesel engine to produce maximum power at maximum efficiency with a minimum of exhaust emissions.

Internal Fuel System

The main fuel system components are the engine driven transfer pump, secondary duplex media type fuel filters (5 micron), fuel unit injectors and a fuel backpressure regulator.

A manual fuel priming pump is also available. This pump is recommended if no electrical priming pump is available.

Fuel Transfer Pump

The engine driven fuel transfer pump is a gear type pump that delivers the fuel through the filters to the injectors. The recommended delivery pressure to the injectors is 800 - 840 kPa (116 to 122 psi) at rated load and speed for C280 engines and 430 - 680 kPa (62 to 99 psi) at rated load and speed for 3600 engines. The delivery pressure is controlled by adjusting the fuel pressure regulator setting on site during commissioning of the engine. The pump is equipped with a pump mounted safety valve and the fuel flow at rated rpm is listed in the technical data and varies with engine speed.

Unit Injectors (EUI)

The fuel unit injectors combine the pumping, metering and injecting elements into a single unit mounted in the cylinder head. External manifolds supply low pressure fuel from the transfer pump to the cylinder heads. High pressure lines are not used. A 100 micron edge type filter is built into each unit injector.

External Fuel System Design Considerations

Diesel fuel supply systems must ensure a continuous and clean supply of fuel to the engine fuel system. The external fuel system typically has three major components: a fuel storage system, a fuel transfer system and fuel filtration system; and each of these systems demand careful attention to ensure the success of each installation.

Fuel Storage System

Tank Location - The tanks should not exceed the height of the engine fuel injectors in order to prevent possible leakage of fuel into the cylinders. If a higher position is unavoidable, then an auxiliary fuel tank or head limiting tank may be required. Otherwise, check valves with backpressures set to the fuel column height must be installed. Caterpillar fuel transfer pumps lifting capability is equivalent to 40 kPa (6 psi) inlet restriction.

Fuel Transfer System

Line Restriction - The piping carrying fuel to the fuel transfer pump and the return line carrying excess fuel to the tank should be no smaller than the engine connections. The maximum inlet flow restriction is 20 kPa (3 psi) at rated speed. Air in the system causes hard starting, erratic engine operation and will erode injectors.

Return Line - The return line should enter the top of the tank without shutoff valves. Bypass (return) fuel leaving the engine pressure regulator should be returned to the

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engine day tank. If the return fuel is cooled and not returned to the day tank, provisions must be made to have the piping system vented for entrapped air and gasses.

Fuel Filtration System

Primary Fuel Filter - Caterpillar recommends the use of a primary filter/strainer prior to the engine transfer pump and offers a duplex, primary filter (178 micron) for this purpose.

Water Separation – Caterpillar also recommends the use of a water and sediment separator in the supply line ahead of the transfer pump, and offers a Racor filter/water separator for this purpose.

Miscellaneous Fuel System Considerations

Flexible Connections - Connections to the engine must be flexible hose and must be located directly at the engine inlet and outlet to accommodate engine motion.

Fuel Temperature - Engines are power set at the factory with 30°C ± 3°C (86°F ±5°F) fuel to the engine transfer pump. Higher fuel temperatures will reduce fuel stop power capability. The “fuel stop” power reduction is 1% for each 5.6°C (10°F) fuel supply temperature increase above 30°C (86°F). If the engine is operating below the “fuel stop” limit, the governor will add fuel as required to maintain the required engine speed. The classification societies have a maximum return to tank fuel temperature. This temperature is related to the fuel flash point. To obtain good fuel filter life, the engine fuel supply temperature should be less than 40°C (104°F). The minimum allowable viscosity of the fuel entering the engine is 1.4 cSt.

Fuel Coolers - The need for fuel coolers is project specific and depends greatly on day tank size and location. See the following table for fuel heat rejection data.

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Fuel Cooler Fuel Flow & Heat Rejection			
Engine	**Rated Speed rpm**	**Fuel Flow to Engine L/min (gal/min)**	**Fuel Heat Rejection kW (Btu/min)**
C280-6/3606	1000	41.5 (11.0)	12.5 (712)
	900	38.0 (10.0)	11.0 (626)
C280-8/3608	1000	41.5 (11.0)	16.7 (951)
	900	38.0 (10.0)	14.6 (831)
C280-12/3612	1000	78.5 (20.7)	25.0 (1423)
	900	72.0 (19.0)	22.0 (1252)
C280-16/3616	1000	78.5 (20.7)	33.3 (1895)
	900	72.0 (19.0)	25.4 (1668)

Fuel Recommendations

The fuels recommended for use in Caterpillar 3600/C280 series diesel engines are normally No. 2-D diesel fuel and No. 2 fuel oil, although No. 1 grades are also acceptable. The following table lists worldwide fuel standards which meet Caterpillar requirements.

Fuel with CIMAC designation DB, commonly referred to as Marine Diesel Oil (MDO), is an acceptable fuel, provided the fuel complies with Caterpillar fuel recommendations.

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Worldwide Fuel Standards[1]		
Standard	**Name**	**Description**
American	ASTM D975	No. 1-D and No. 2-D Diesel Fuel Oils
	ASTM D396	No. 1 and No. 2 Fuel Oils
	ASTM D2880	No. 1-GT and No. 2-GT Gas Turbine Fuels
British	BS 2869	Classes A1, A2 and B2 Engine Fuels
	BS 2869	Classes C2 and D Burner Fuels
West German	DIN 51601	Diesel Fuel
	DIN 51603	Heating Oil El
Australian	AS 3570	Automotive Diesel Fuel
Japanese	JIS K2204	Types 1 (spl), 1, 2, 3, and 3 (spl) Gas Oil
U.S. Government	W-F-800C	DF-1, DF-2 Conus and DF-20 Conus Diesel Fuel
	W-F-815C	FS-1 and FS-2 Burner Fuel Oil
U.S. Military	MIL-L-16884G	Marine Oil
1. These fuel standards are usually acceptable, but are subject to change. The distillate fuel chart for acceptable limits should be used as the guide for any fuel whether or not it is listed in this chart (consult Caterpillar A&I for acceptability of any other fuels).		

Customer Piping Connections

Engine Fuel Line Connections

Fuel Supply	Excess Fuel Return
38 mm (1-1/2 in.) ANSI Flange	38 mm (1-1/2 in.) ANSI Flange

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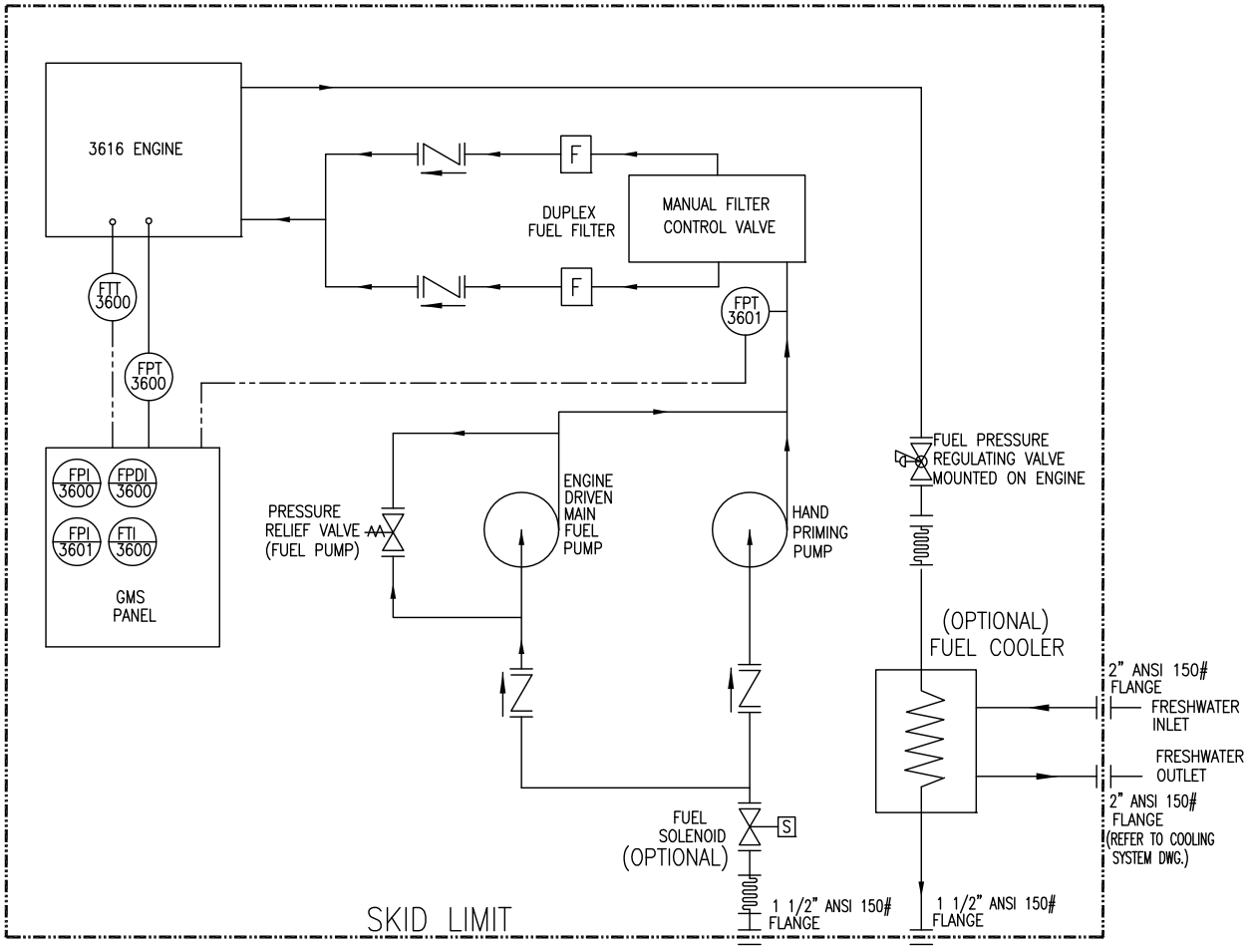
Fuel System Schematic

A typical fuel system is illustrated below.



LEGEND	DESCRIPTION
F	DUPLEX FILTER
	PUMP
	CHECK VALVE
	FLEXIBLE HOSE
	ELECTRICAL LINE
	PROCESS LINE
	SKID LIMIT

TAG NO.	DESCRIPTION
FPDI 3600	FUEL FILTER DIFFERENTIAL PRESSURE READOUT
FPI 3600	FUEL FILTER PRESSURE READOUT
FPI 3601	FUEL UNFILTER PRESSURE READOUT
FPT 3600	FILTERED FUEL PRESSURE TRANSMITTER
FPT 3601	UNFILTERED FUEL PRESSURE TRANSMITTER
FTI 3600	FUEL TEMPERATURE READOUT
FTT 3600	FUEL TEMPERATURE TRANSMITTER

METRIC

	1E2733	DRAWING – AUTOCAD
	1E0013Y	CONFIDENTIALITY
NOTE	1E0011	INTPR & TOL
NOTE	**Caterpillar: Confidential Yellow**	
CUSTOM PROD.	X	ENGINE MODEL: C280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		SCALE 1 = 20 (0 10mm 20 30)
THIRD ANGLE PROJECTION		SHEET 1 OF 5
		DWG CONTROL W118

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CUSTOMER: MARKETING GUIDE			
END USER:			
PROJECT: C280			
TITLE: P&ID– FUELING SYSTEM			
309–4954	VER –	CHG 00	D

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Cooling System

General

The cooling system configuration for the Caterpillar C280/3600 series diesel engine in petroleum offshore applications can be either the separate circuit system or the combined circuit system, also referred to as the single circuit - two pump system. The selection of either of these systems is based on several criteria:

1. Applicable emission requirements, i.e. EPA Tier 2 or IMO.
2. Petroleum offshore rig site location and available sea water temperature.

The heat rejection data in this project guide are based on 32°C (90°F) water to the aftercooler and 45°C (113°F) air to the turbocharger inlet. The cooling system is laid out for the following temperature levels:

1. 32°C (90°F) nominal water temperature to the aftercooler and oil cooler (IMO allows 38°C (104°F) water with 25°C (77°F) ambient sea water; and EPA Tier 2 requires 32°C (90°F) water with 27°C (81°F) ambient sea water).
2. 90°C (194°F) nominal jacket water temperature to the cylinder block (93°C thermostatic valve is used for heat recovery applications).
3. 85°C (185°F) nominal oil temperature to bearings.

Internal Cooling System

Fresh Water Pumps

The C280/3600 engine has two identical gear-driven centrifugal water pumps mounted on the front housing. The right-hand pump (viewed from the flywheel end) supplies coolant to the block and heads. The left-hand pump supplies coolant to the aftercooler and oil cooler.

External Cooling System Design Considerations

Coolant Flow Control

The correct coolant flows are obtained by factory installed orifices on the engine, combined with proper external circuit resistance set at each site during commissioning, either with customer installed orifices or balancing valves, although a lockable plug valve is recommended. The external circuit resistance setting establishes the total circuit flow by balancing total circuit losses with the characteristic pump performance curves. Correct external resistance is very important. Too high a resistance will result in reduced flows to the aftercooler and oil cooler, and their effectiveness will decrease. If there is too low a resistance, the fluid velocity limits may be exceeded, and cavitation / early wear could be the result.

Note: Factory packaged cooling systems eliminate the need for the customer to set external resistance for engine cooling circuits at site. Proper flow rates for the engine cooling circuits of a factory packaged cooling system are designed by Caterpillar and tested during the Factory Acceptance Test.

Listed below are the recommended external resistance maximum pressure drops for C280/3600 engines.

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C280-6 and C280-8/3606 and 3608 Combined Circuit

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	91 (13)	130% of 91 (13)
900	71 (10)	130% of 71 (10)

C280-12 and C280-16/3612 and 3616 Combined Circuit

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	85 (12)	130% of 85 (12)
900	66 (9.6)	130% of 66 (9.6)

C280-6 and C280-8/3606 and 3608 Separate Circuit (Low Temperature Circuit)

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	104 (15)	130% of 104 (15)
900	84 (12)	130% of 84 (12)

C280-6 and C280-8/3606 and 3608 Separate Circuit (High Temperature Circuit)

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	99 (14)	130% of 99 (14)
900	77 (11)	130% of 77 (11)

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C280-12 and C280-16/3612 and 3616 Separate Circuit (Low Temperature Circuit)

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	85 (12)	130% of 85 (12)
900	66 (9.6)	130% of 66 (9.6)

C280-12 and C280-16/3612 and 3616 Separate Circuit (High Temperature Circuit)

Engine Speed RPM	C280/3600 Differential Press kPa (PSI) Full cooler flow	C280/3600 Differential Press kPa (PSI) Full by-pass flow
1000	103 (15)	130% of 103 (15)
900	81 (12)	130% of 81 (12)

Coolant Temperature Control

The C280/3600 engine uses fluid inlet control temperature regulators to provide uniform coolant temperature to the aftercooler, oil cooler, and cylinder block. For the combined circuit system, the AC/OC circuit is externally regulated to provide a nominal 32°C (90°F) coolant temperature. The high temperature jacket water system uses the AC/OC outlet water to maintain 90°C (194°F) inlet water to the block. For the separate circuit system, both the AC/OC and jacket water systems are externally regulated, using sea water to maintain the required 32°C (90°F) AC/OC and 90°C (194°F) jacket water temperatures.

Sea Water Pump (customer furnished)

The seawater pump is typically supplied by the customer because the optionally supplied Caterpillar engine mounted sea water pump does not have sufficient suction capability to lift water from sea level to the engine room on a typical offshore platform.

Expansion Tanks

Expansion tanks are available from Caterpillar as standard options. The combined circuit expansion tank is full flow. For separate circuit cooling, the jacket water expansion tank is full flow and the AC/OC expansion tank is a shunt type.

Heat Exchangers

Caterpillar offers heat exchangers of the plate and frame type. Heat exchanger sizing and performance depends on emission requirements, water flow and temperature differential. Control of the sea water velocity must be maintained to avoid erosion problems with the heat exchangers.

Heat Exchanger Sizing

The minimum acceptable heat exchanger configuration for either the separate circuit system or combined circuit system must provide coolant temperature at the AC/OC pump inlet in accordance with applicable emission requirements, and must consider the following:

1) Maximum expected ambient temperature

2) Maximum engine power capability (rack stop setting)

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3) Maximum expected sea-water temperature

4) Expected sea-water fouling factor

5) Anticipated coolant composition (i.e. 50% glycol).

See the technical data section of this project guide for specific heat rejection figures.

Jacket Water Heaters

Jacket water heaters may be required to meet cold starting and load acceptance criteria. To provide for the optimum usage of the heater, Caterpillar routes the heater water into the top of the cylinder block and exit at the bottom to maintain block temperature. Caterpillar offers an optional 15 kW heater for 3606/C280-06 engine installations, and a 30 kW heater for 3608/C280-08 & larger engine installations.

System Pressures

Correct cooling system pressure minimizes pump cavitation and increases pump efficiency. The combination of static and dynamic pressure heads must meet the pressure criteria listed in the technical data.

Venting

Proper venting is required for all applications. Vent lines should be routed to an expansion tank at a constant upward slope.

System Monitoring

During the design and installation phase it is important that provisions are made to measure pressure and temperature differentials across major system components. This allows accurate documentation of the cooling system during the commissioning procedure. Future system problems or component deterioration (such as fouling) are easier to identify if basic data is available.

Serviceability

Suitable access should be provided for cleaning, removal or replacement of all system components. Isolation valves should be installed as deemed necessary to facilitate such work.

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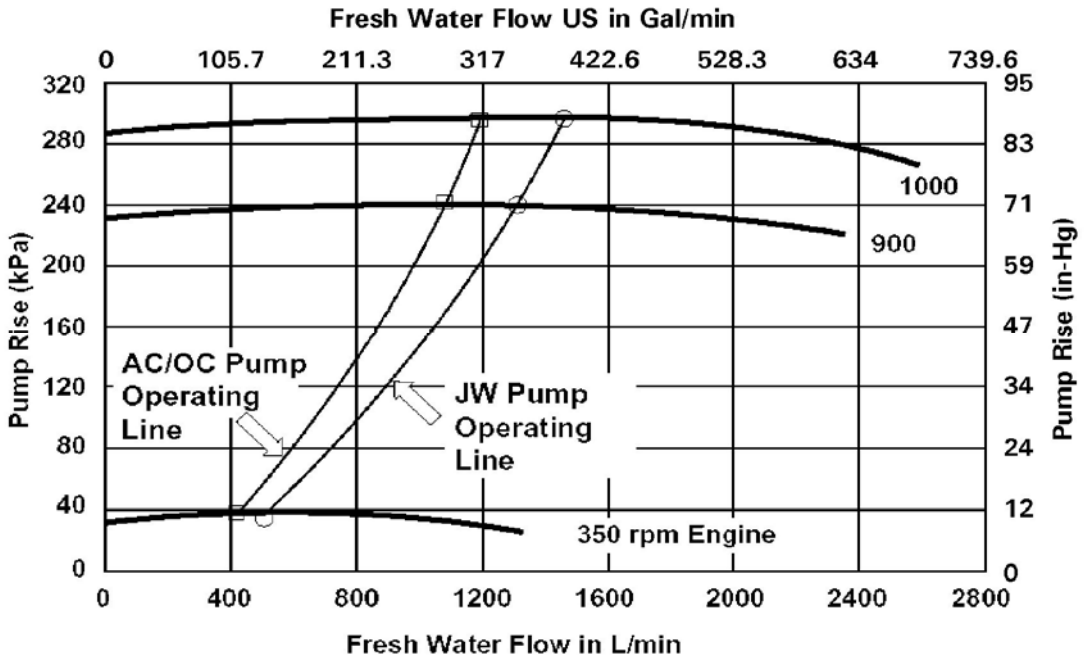
System Pressures and Velocities

The following pressure and velocity limits apply to C280/3600 series engines:

Water Pump Pressures	
Maximum allowable Static Head	145 kPa (21 psi)
Minimum AC/OC Inlet Pressure (dynamic)	-5 kPa (-0.7 psi)
Minimum JW inlet Pressure (dynamic)	30 kPa (4 psi)
Minimum Sea Water Inlet Pressure (dynamic)	-5 kPa (-0.7 psi)
Maximum Operating Pressures	
Engine Cooling Circuits	500 kPa (73 psi)
Caterpillar Expansion Tanks	150 kPa (22 psi)
Heat Exchangers	Type Specific
Water Velocities	
Pressurized Lines	4.5 m/s (15 ft/s)
Pressurized Thin Walled Tubes	2.0 to 2.5 m/s (7 to 8 ft/s)
Suction Lines (Pump Inlet)	1.5 m/s (5 ft/s)
Low Velocity De-aeration Line	0.6 m/s (2 ft/s)

Jacket Water and AC/OC Pump
C280-6/8 and 3606/8 Engines



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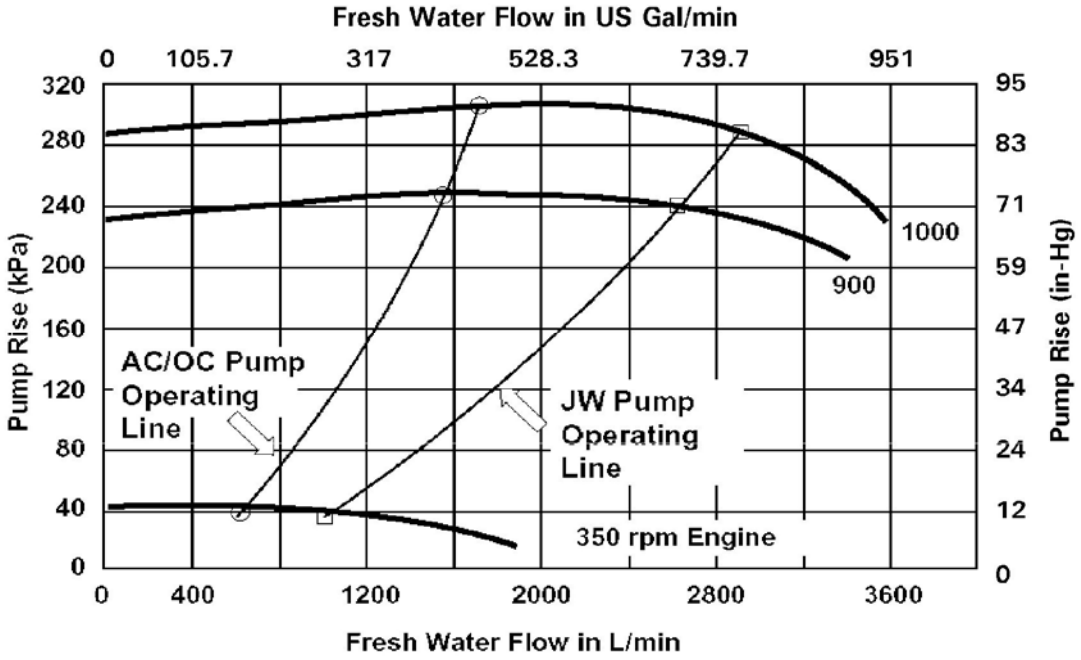
Jacket Water and AC/OC Pump
C280-12/16 and 3612/16 Engines



Heat Recovery

Water Maker

For engines with a Combined Circuit Cooling System, heat recovery connections are available for the customer to route Jacket Water (or High Temperature) Circuit water from the outlet of the engine block to a water maker heat exchanger and then return the water to an inlet on the combined circuit mix box (temperature regulator) on the engine.

For engines with a Separate Circuit Cooling System, heat recovery connections are not required, as the Jacket Water (or High Temperature) Circuit is already isolated.

For both types of cooling systems, Caterpillar is able to provide a complete cooling system to include a water maker heat exchanger, heat recovery circuit temperature regulator and required piping to meet the customer's project specific needs.

Generator Cooling

Generators can be furnished either air cooled or water cooled. Air cooled generators must be included in the ventilation system sizing considerations. Water cooled generators are typically sea water cooled; and similar to the engine's sea water pump, the generator sea water pump will be customer furnished. This pump must have sufficient suction capability to lift water from sea level to the engine room on a typical offshore platform. Depending on the overall cooling system configuration, generator cooling water can be supplied from a separate pump or combined with the engine's sea water pump supply capacity.

Cooling Water Requirements

Water Quality, Rust Inhibitors and Antifreeze

Maintaining water quality is very important in closed cooling systems. Excessive hardness will cause deposits, fouling and reduced effectiveness of cooling system

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components. Caterpillar has available coolant inhibitor to properly condition the cooling water. When using Caterpillar inhibitor, the cooling water piping must not be galvanized and aluminum should not be used. If the piping is galvanized, the zinc will react with the coolant inhibitor and form clogs, which will interfere with the system operation.

Customer Piping Connections

Engine Connections	
Engine Cooling Water Inlet/Outlet	6 in. ANSI Flange
Engine Sea Water Inlet/Outlet	6 in. ANSI Flange
Generator Cooling Water Inlet/Outlet	DN50, DIN 2633 Flange
Water Maker Supply/Return	4 in. ANSI Flange
Package Connections	
Package Sea Water Inlet/Outlet	6 in. ANSI Flange

Available in CAT standard, ANSI standard, or DIN standard. CAT standard weld flanges at every connection point, ANSI or DIN can be furnished.

Cooling System Schematics

Typical Combined Circuit and Separate Circuit Cooling Systems are illustrated on the following pages.

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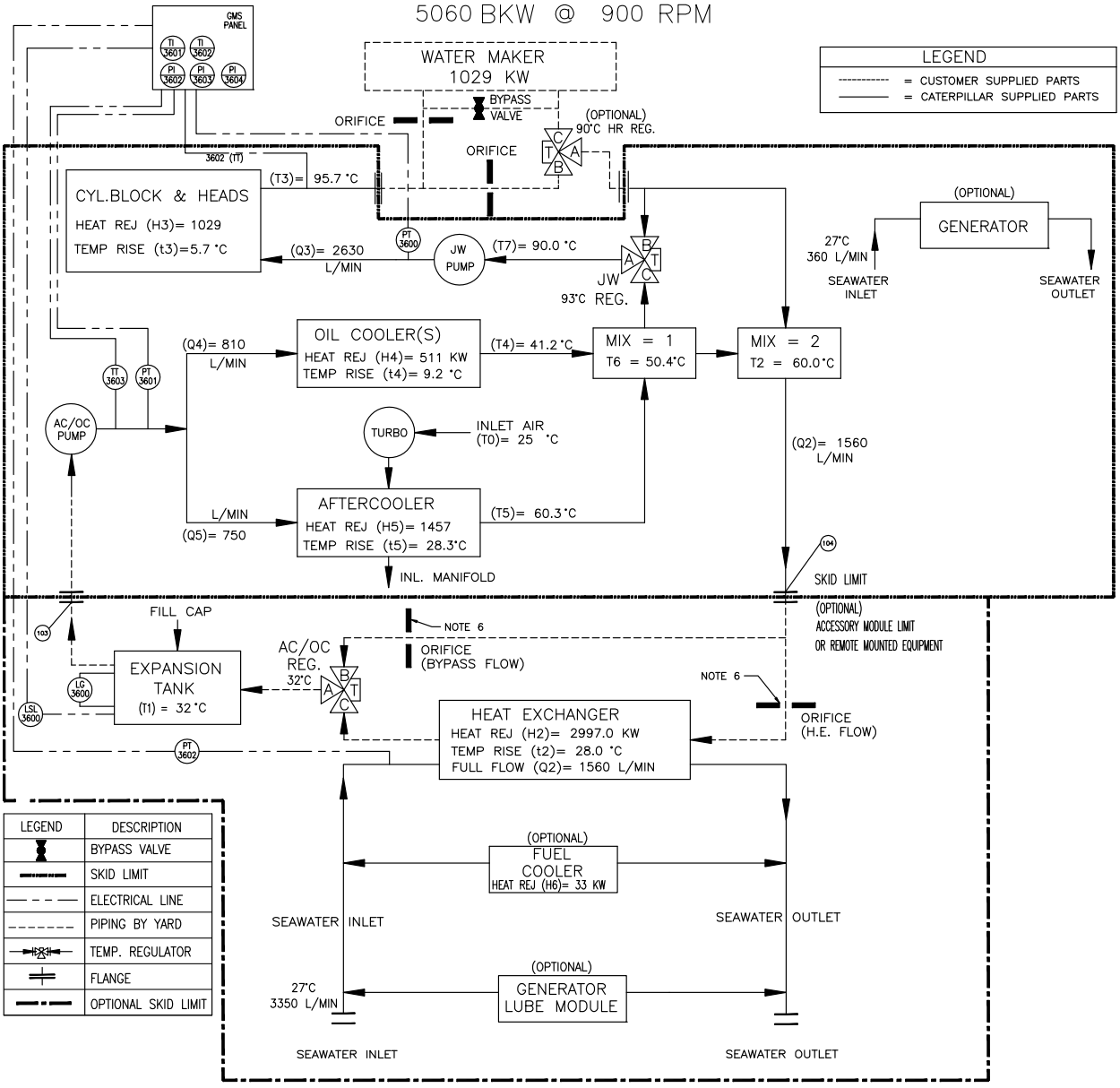
C280–16 COMBINED COOLING SYSTEM
5060 BKW @ 900 RPM



LEGEND	DESCRIPTION
	BYPASS VALVE
	SKID LIMIT
	ELECTRICAL LINE
	PIPING BY YARD
	TEMP. REGULATOR
	FLANGE
	OPTIONAL SKID LIMIT

LEGEND	
----------	= CUSTOMER SUPPLIED PARTS
———	= CATERPILLAR SUPPLIED PARTS

NOTES:

1. CONNECTION LOCATIONS SHOWN IN THIS SCHEMATIC ARE FOR ILLUSTRATIVE PURPOSES ONLY.
2. HEAT REJ. AND TEMPERATURE DATA BASED ON 50/50 GLYCOL MIXTURE
3. DATA BASED ON 25° AMBIENT AND 32° WATER TO AC
4. HEAT REJECTION TOLERANCES: COOLANT FLOW = ±10%
   HEAT REJECTION = ±10%
   TOLERANCES ACCOUNT FOR ENGINE-TO-ENGINE VARIATION TEST DATA ACCURACY, REPEATABILITY, AND SCATTER. THE HEAT REJECTION TOLERANCE BAND DOES NOT ACCOUNT FOR ON SITE CONDITIONS SUCH AS AMBIENT AND ALTITUDE. TOLERANCE GUIDELINES CAN BE FOUND IN THE 3600 EPG APPLICATION AND INSTALLATION GUIDE (LEKX1002).
5. MAXIMUM ALLOWABLE ENGINE EXTERNAL COOLING SYSTEM PRESSURE DROP SHALL NOT EXCEED CATERPILLAR GUIDE LINES. FOR SPECIFIC GUIDELINES AND TEST POINT LOCATIONS SEE THE CATERPILLAR 3600 APPLICATION AND INSTALLATION GUIDE, COOLING SYSTEM SECTION. ALL ORIFICES SHOWN ARE SUPPLIED BY OTHERS.
6. CUSTOMER SUPPLIED FLOW SETTING ORIFICE.

TAG NO.	DESCRIPTION
LG 3600	WATER LEVEL GAUGE
LSL 3600	LOW WATER LEVEL SWITCH
PT 3600	JACKET WATER PUMP PRESSURE TRANSMITTER
PT 3601	AC/OC WATER PUMP PRESSURE TRANSMITTER
PT 3602	RAWWATER PRESSURE TRANSMITTER
TI 3601	ENGINE COOLANT TEMPERATURE GAUGE
TS 3604	JACKET WATER TEMPERATURE SWITCH (ALARM)
TS 3605	JACKET WATER TEMPERATURE SWITCH (SHUTDOWN)
TT3602	JACKET WATER OUTLET TEMPERATURE TRANSMITTER
TT3603	AC/OC INLET TEMPERATURE TRANSMITTER

METRIC

	1E2733	DRAWING – AUTOCAD	
NOTE	1E0011	INTPR & TOL	
	SPEC NO.	NAME	
CON-CEPT	EXP	PRE PROD.	PROD.
ENGINE MODEL: C280–16			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC			
SCALE – – –			
0 10mm 20 30			
SHEET 1 OF 1	THIRD ANGLE PROJECTION	CHG	DATE

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INSTALLATION DRAWINGS
P&ID COOLING SYSTEM
C280–GUIDE | VER – | CONTROL DES SUB | D

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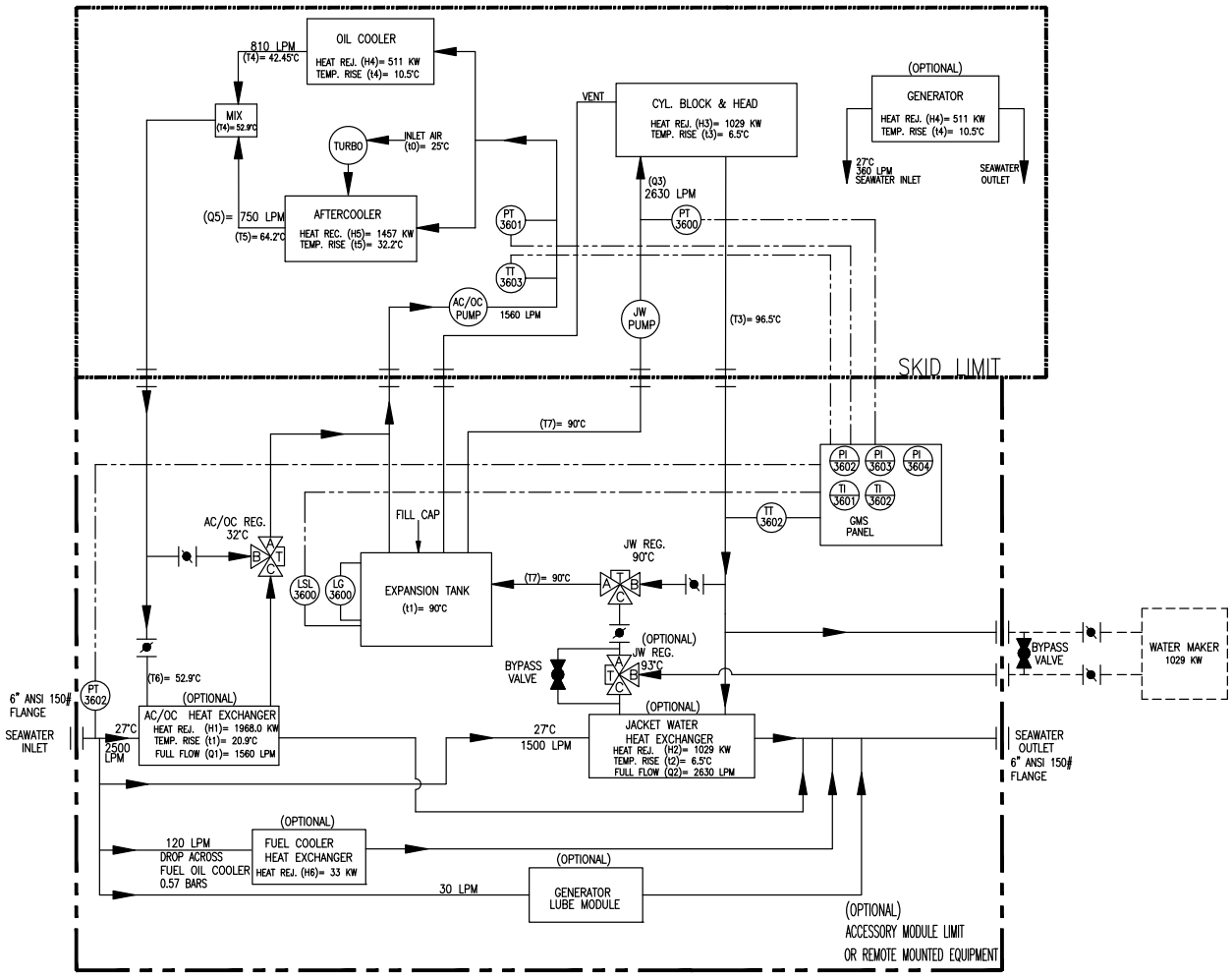
C280–16 SEPARATE CIRCUIT COOLING SYSTEM
5060 BKW @ 900 RPM



LEGEND	DESCRIPTION
	TEMP. REGULATOR
	SKID LIMIT
	ELECTRICAL LINE
	PIPING BY YARD
	BUTTERFLY VALVE
	FLANGE
	OPTIONAL SKID LIMIT

TAG NO.	DESCRIPTION
LG 3600	WATER LEVEL GAUGE
LSL 3600	LOW WATER LEVEL SWITCH
PT 3600	JACKET WATER PUMP PRESSURE TRANSMITTER
PT 3601	AC/OC WATER PUMP PRESSURE TRANSMITTER
PT 3602	RAWWATER PRESSURE TRANSMITTER
TI 3601	ENGINE COOLANT TEMPERATURE GAUGE
TS 3604	JACKET WATER TEMPERATURE SWITCH (ALARM)
TS 3605	JACKET WATER TEMPERATURE SWITCH (SHUTDOWN)
TT3602	JACKET WATER OUTLET TEMPERATURE TRANSMITTER
TT3603	AC/OC INLET TEMPERATURE TRANSMITTER

NOTES:

1. CONNECTION LOCATIONS SHOWN IN THIS SCHEMATIC ARE FOR ILLUSTRATIVE PURPOSES ONLY.
2. HEAT REJ. AND TEMPERATURE DATA BASED ON 50/50 GLYCOL MIXTURE
3. DATA BASED ON 25° AMBIENT AND 32° WATER TO AC
4. HEAT REJECTION TOLERANCES: COOLANT FLOW = ±10%
   HEAT REJECTION = ±10%
   TOLERANCES ACCOUNT FOR ENGINE-TO-ENGINE VARIATION TEST DATA ACCURACY, REPEATABILITY, AND SCATTER. THE HEAT REJECTION TOLERANCE BAND DOES NOT ACCOUNT FOR ON SITE CONDITIONS SUCH AS AMBIENT AND ALTITUDE. TOLERANCE GUIDELINES CAN BE FOUND IN THE 3600 EPG APPLICATION AND INSTALLATION GUIDE (LEKX1002).
5. MAXIMUM ALLOWABLE ENGINE EXTERNAL COOLING SYSTEM PRESSURE DROP SHALL NOT EXCEED CATERPILLAR GUIDE LINES. FOR SPECIFIC GUIDELINES AND TEST POINT LOCATIONS SEE THE CATERPILLAR 3600 APPLICATION AND INSTALLATION GUIDE, COOLING SYSTEM SECTION. ALL ORIFICES SHOWN ARE SUPPLIED BY OTHERS.
6. CUSTOMER SUPPLIED FLOW SETTING ORIFICE.

METRIC

	1E2733	DRAWING – AUTOCAD
	1E0013Y	CONFIDENTIALITY
NOTE	1E0011	INTPR & TOL
	Caterpillar: Confidential Yellow	
CUSTOM PROD.	X	ENGINE MODEL: C280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		SCALE 1 = 20
THIRD ANGLE PROJECTION		SHEET 2 OF 5
		DWG CONTROL W118

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CUSTOMER: MARKETING GUIDE			
END USER:			
PROJECT: C280			
TITLE: P&ID–COOLING SYSTEM			
309–4954	VER –	CHG 00	D

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Starting Air System

General

The air starting system supplied by Caterpillar includes air starters, lubricator (not required for turbine starters), air relay valve, strainer, shut off valve and pressure regulator, if required. 3600 Series engines use vane type starters as standard equipment, with optional turbine starters by design-to-order. C280 Series engines use TDI turbine starters.

Internal Starting Air System

The standard vane air starters and turbine starters operate on air inlet pressures from 700 to 1040 kPa (102 to 151 psi). These pressures are required at the starter inlet port. An air tank pressure below 700 kPa (102 psi) will not start the engine because of the pressure drop associated with the air supply lines. For initial system evaluation, assume a 200 kPa (29 psi) pressure drop between the tank and the air starter inlet.

A pressure regulator (available as an option in the pricelist) is necessary when the supply pressure exceeds the starter operating pressure. The pressure regulator should be set from 700 to 1040 kPa (102 to 151 psi). It should have the capacity to flow 300 l/sec (79 gal/sec) per starter at regulator inlet pressures above 860 kPa (125 psi) (regulators with a Cv of 40 or higher are recommended).

The quantity of air required for each start and the size of the air receiver depend upon cranking time and air-starter consumption. A typical first start at 25°C (77°F) ambient will take five to seven seconds. Restarts of warm engines normally take place in two to three seconds. The control system will shut off the air to the air starters at 170 rpm engine speed. At this firing speed, the governor is activated to allow fuel to the engine.

External Starting Air System Design Considerations

The charts on the following pages are for typical air receiver sizing. The chart shows the number of starts available with an initial starting air receiver pressure as shown on the curves. The starting air receiver size is normally determined by the requirements of the classification society for the number of starts or start attempts.

The size of the air receivers should be increased if the starting air receiver also supplies air for purposes other than the main engine starting (e.g. engine air prelube, work air, auxiliary gensets). The Caterpillar intermittent air prelube pump consumption rate is 28.2 l/sec (7.45 gal/sec) based on free air at 21°C (70°F) at 100 kPa (15 psi). The pump motor operating pressure is 690 kPa (100 psi). With the redundant prelube system and the continuous prelube pump running at startup, the pneumatic intermittent prelube pumps for the engine and generator will operate for no longer than 15 seconds. For generator sets with pneumatic intermittent prelube pump only, the prelube pump will normally operate 1 to 5 minutes before the engine begins to crank.

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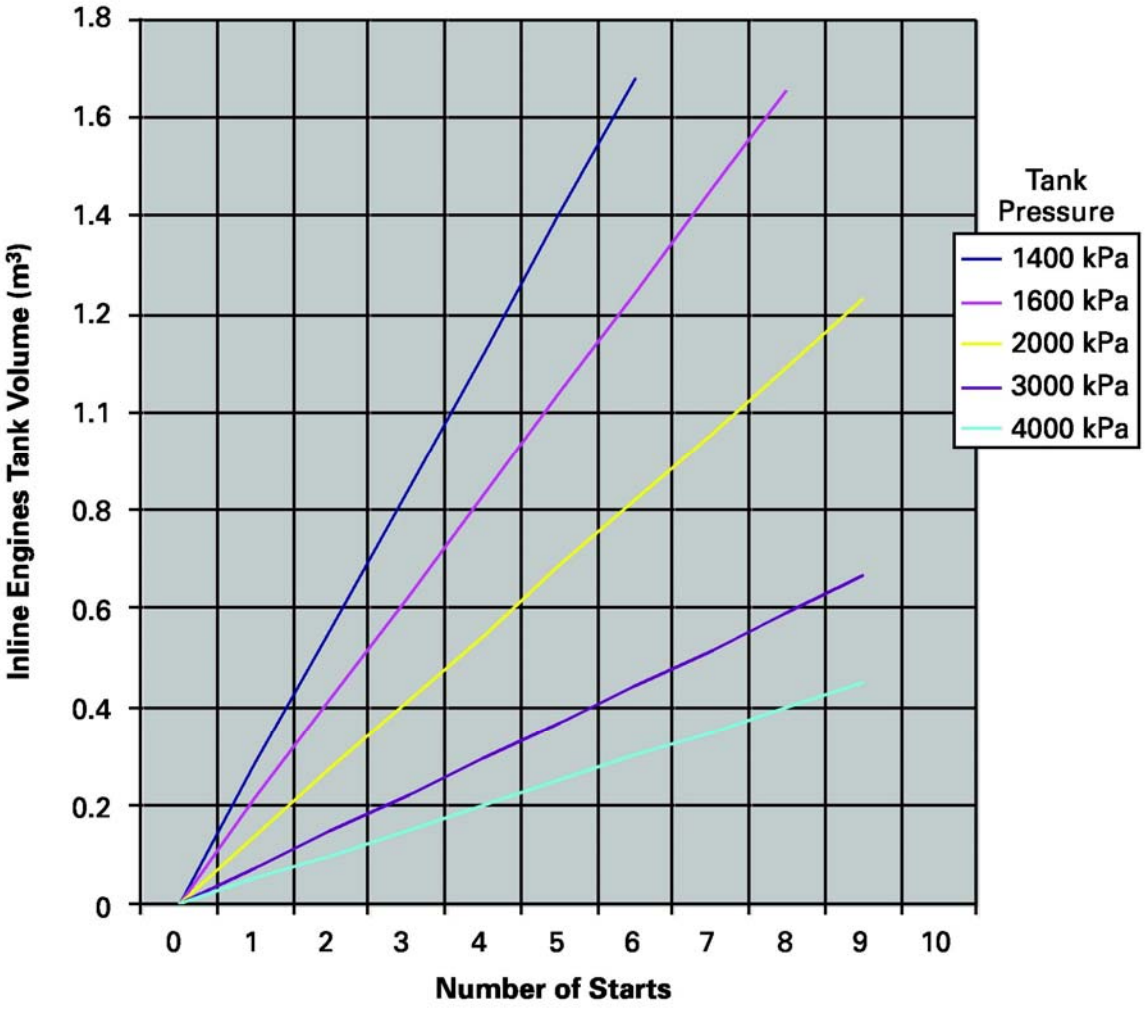
Air Tank Sizing for Engines with 1 TDI T109 Starter

assuming 5 seconds start @ 620 kPa



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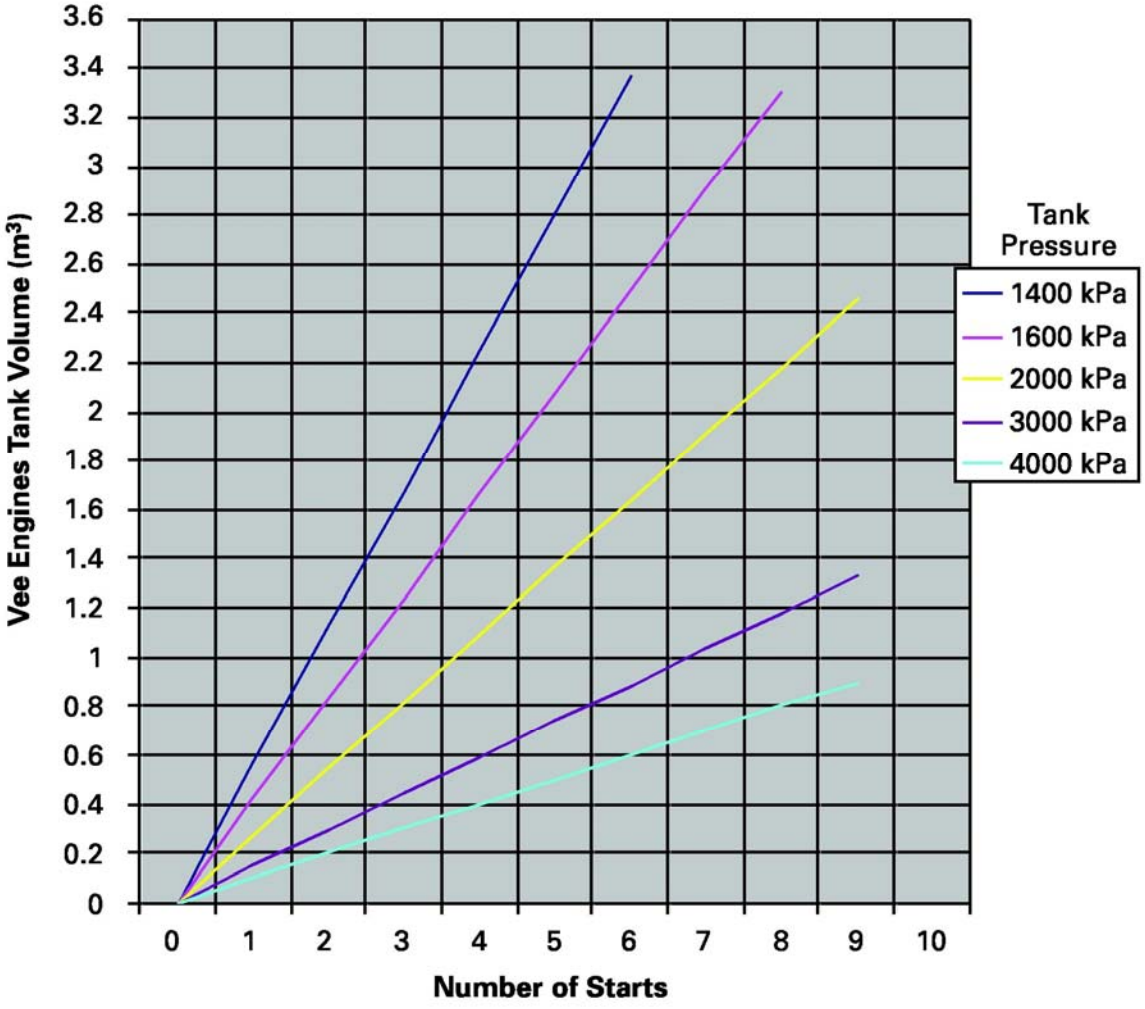
Air Tank Sizing for Engines with 2 TDI T109 Starters

assuming 5 seconds start @ 620 kPa



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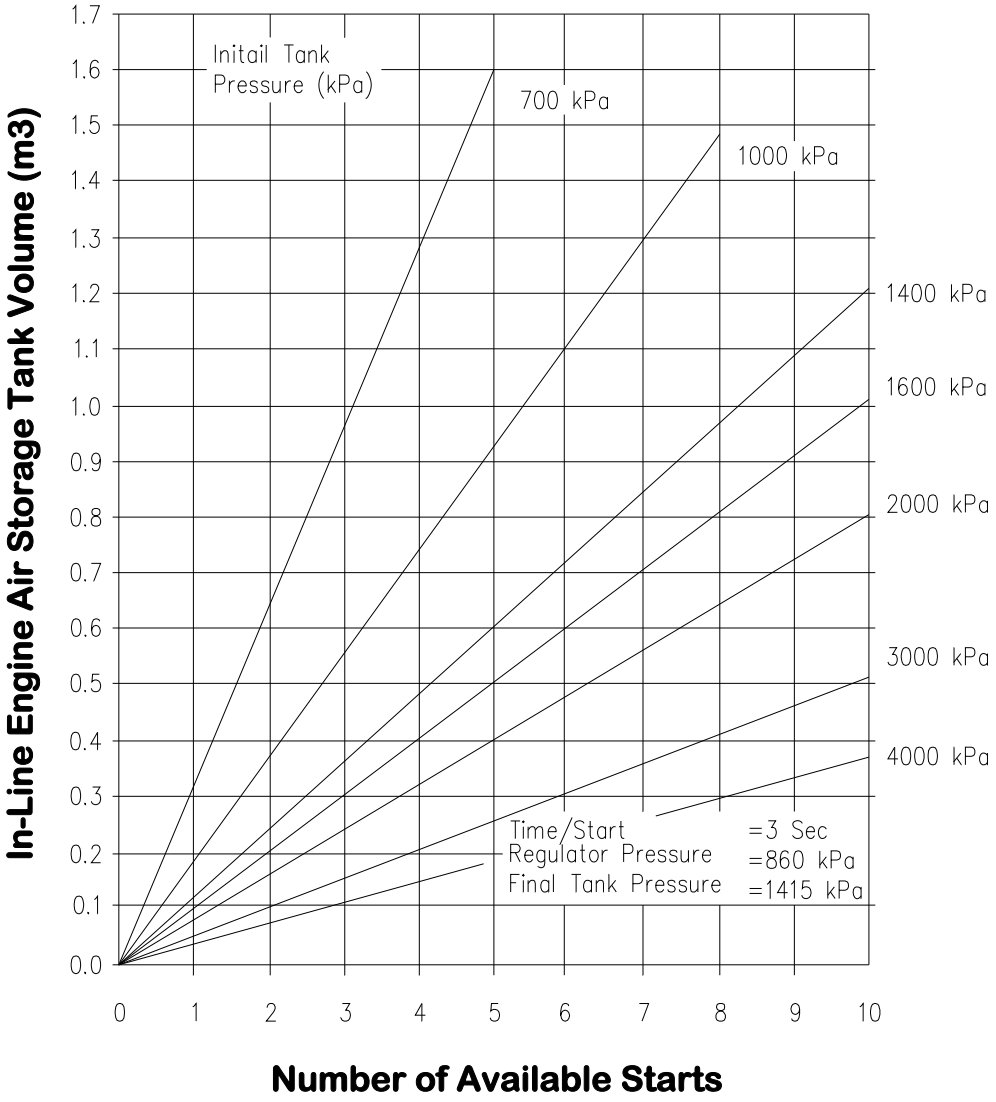
Air Tank Sizing for 3600 Engines with 1 Vane Starter



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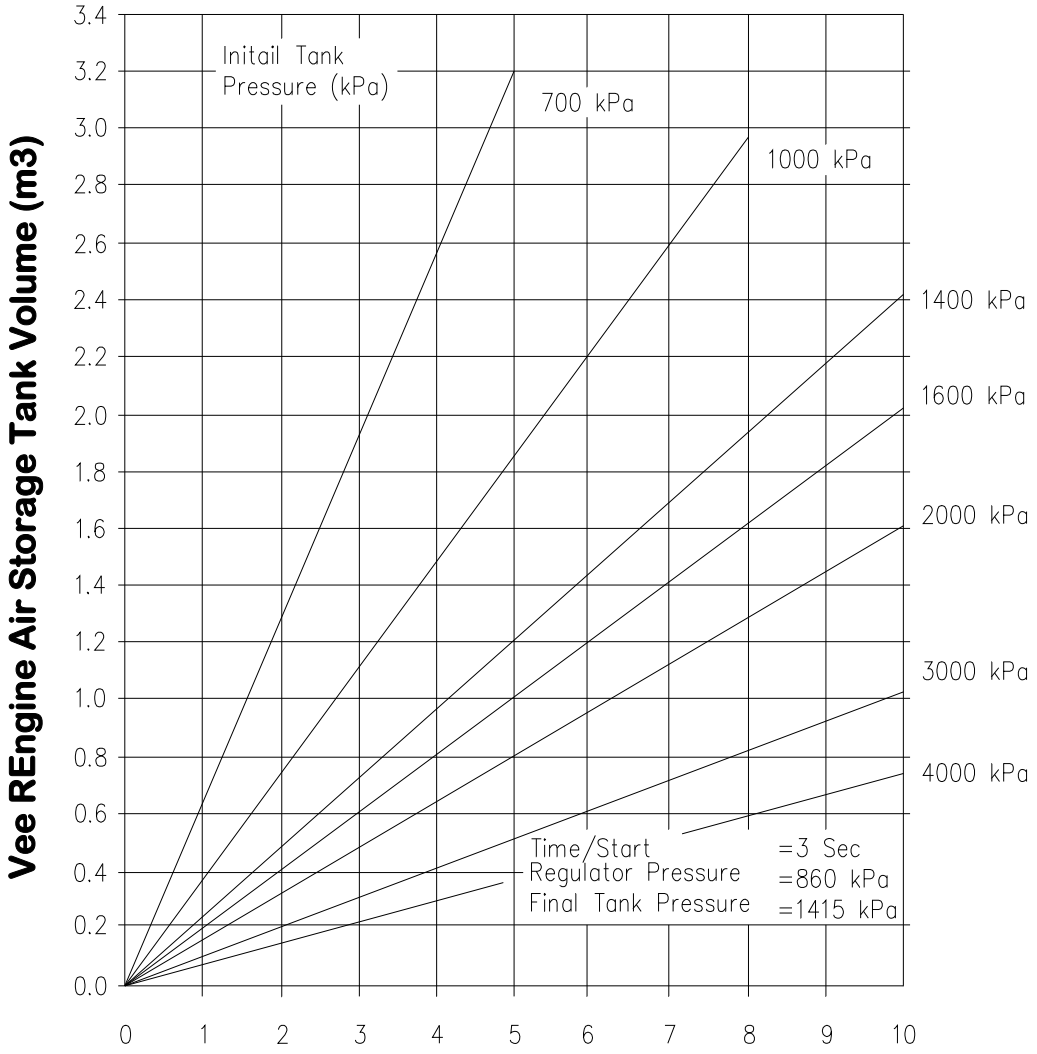
Air Tank Sizing for 3600 Engines with 2 Vane Starters



Engine Piping Connections

Vane and turbine type starters must be supplied with clean air. Deposits of oil-water mixture must be removed by traps installed in the lines. Lines should slope towards the traps and away from the engine. The air supply pipes should be short with number of elbows kept to a minimum and at least equal in size to the engine inlet connection, which is 1-1/2 in. NPTF. (For the engines with dual starters supply line should be at least 63.5 mm (2.5 in.) in diameter). If the supply line must be longer than 6 m (20 ft) the piping size should be increased to ensure proper starters performance. The flexible connection between engine starting line and supply line should be used to prevent vibration induced fatigue.

If a pressure reducing valve is required, a valve with Cv40 should be used to provide sufficient air flow. Locate the pressure reducing valve as close to the engine as possible to minimize the air pressure reduction valve supply pipe diameter.

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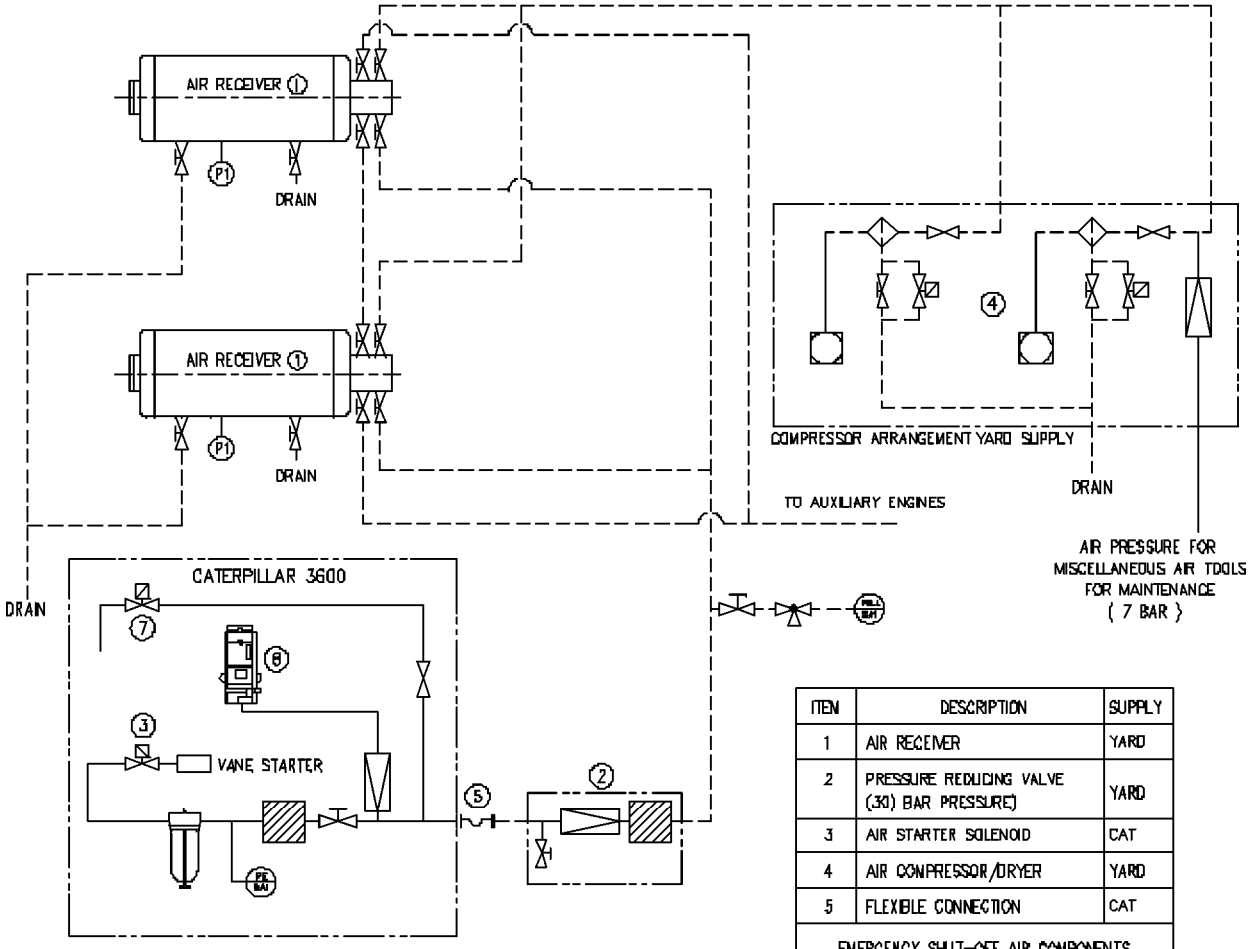
Starting Air System Schematic

A typical starting air system is illustrated on the following page.

STARTING AIR SYSTEM

With Emergency Air Shutoff and Oil Mist Detector



ITEM	DESCRIPTION	SUPPLY
1	AIR RECEIVER	YARD
2	PRESSURE REDUCING VALVE (30) BAR PRESSURE)	YARD
3	AIR STARTER SOLENOID	CAT
4	AIR COMPRESSOR/DRYER	YARD
5	FLEXIBLE CONNECTION	CAT
ENERGENCY SHUT-OFF AIR COMPONENTS		
7	EMERGENCY SHUT-OFF SOLENOID	CAT
OIL MIST DETECTOR COMPONENTS		
6	OIL MIST DETECTOR	CAT

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Combustion Air System

General

The aftercooler system is a High Performance Air Cooling (HPAC) system designed in a modular layout. The aftercooler inlet section is insulated with a soft wrap insulation to comply with marine society rules for surface temperature. The top covers of the three aftercooler sections are provided with a screen for protection and insulation. The flexible bellow joints are connected by means of V-shaped clamps and the use of metallic C-rings.

The maximum inlet air temperature to the turbocharger is 49°C (120°F). This temperature is in accordance with the marine society rules for equipment performance and will provide good engine component life. For temperatures above 30°C (86°F), the engine may be derated to a power output level that will provide for safe engine operation; check with Caterpillar A&I Engineering.

The C280/3600 Engine will normally draw engine combustion air in one of two ways:

1. The engine room is supplied with filtered air for engine combustion as well as for removal of radiated heat from the engine room.

2. The engine room is supplied with ventilation air for engine heat removal and the engine combustion air is supplied separately through a dedicated air intake system, which provides filtered air for the combustion only.

Either system should be designed to provide sufficient clean air for combustion and heat removal based on the ambient conditions and the maximum ratings for each piece of installed equipment (i.e. marine auxiliary engines, pumps, and switchgear). For classed vessels, the specific societies have well defined rules for the design parameters.

Combustion Air System Design Considerations

Engine Room Supplied Air

The location and design of the engine room air intakes should consider the following:

1. The supply air outlets should be close to and directed at the engine turbocharger air intakes.

2. Additional air should flow along the engine, coupling, and reduction gear to absorb the radiated heat.

3. The engine room air inlets should be placed such that water or dirt cannot enter.

A typical combustion air piping system is illustrated on page 85.

Separate Combustion Air System

Supplying the engines with direct outside air for combustion if possible is beneficial to the installation for a number of reasons. It will bring down the air movement in the engine room, may reduce the cooling load on the charge air cooler and thus reduce the maximum heating load on the cooling water heat exchanger. This in turn will reduce the required sea water circulation in the system. Direct air to the turbocharger inlet will provide a bigger margin to the point where engine load reduction is needed due to high air inlet temperatures. It would be expected that if the turbocharger inlets are supplied with engine room supplied air a temperature rise above ambient of 5 to 10°C (9 to 18°F)

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would take place. By supplying the engines with direct outside air the vessel will also save on the required fan work.

If the engine combustion air is supplied through a separate, dedicated air system, the engine room design should consider the following.

1. The entire intake system, including clean air filters should have an initial restriction of no greater than 122 mm H_2O (4.8 in. H_2O).

2. The maximum inlet restriction with dirty air filters should not exceed 380 mm H_2O (15 in. H_2O).

3. Flexible connections are necessary to isolate engine vibration from the ducting system. Locate the flex connection as close to the engine as possible, but be aware of the excessive heat generated by the exhaust system.

4. Avoid supporting excessive lengths of ductwork off the turbocharger. The maximum allowable moment on the turbocharger is 300 Nm (221 ft-lb).

5. Caterpillar has specially designed the air intake components to provide the proper airflow pattern before the turbocharger. Turbocharger performance may be adversely affected if these components are not used.

General

The amount of combustion air necessary for the C280/3600 Engine is specified in the technical data section of this manual. The amount of radiated heat emitted by each engine is also specified.

Installations intended for operation in extreme cold may require heated air for starting purposes. In addition, it may be necessary to control the inlet boost pressure for cold air installations. Contact your Caterpillar dealer or the regional Caterpillar representative for further information when extreme ambient conditions are expected.

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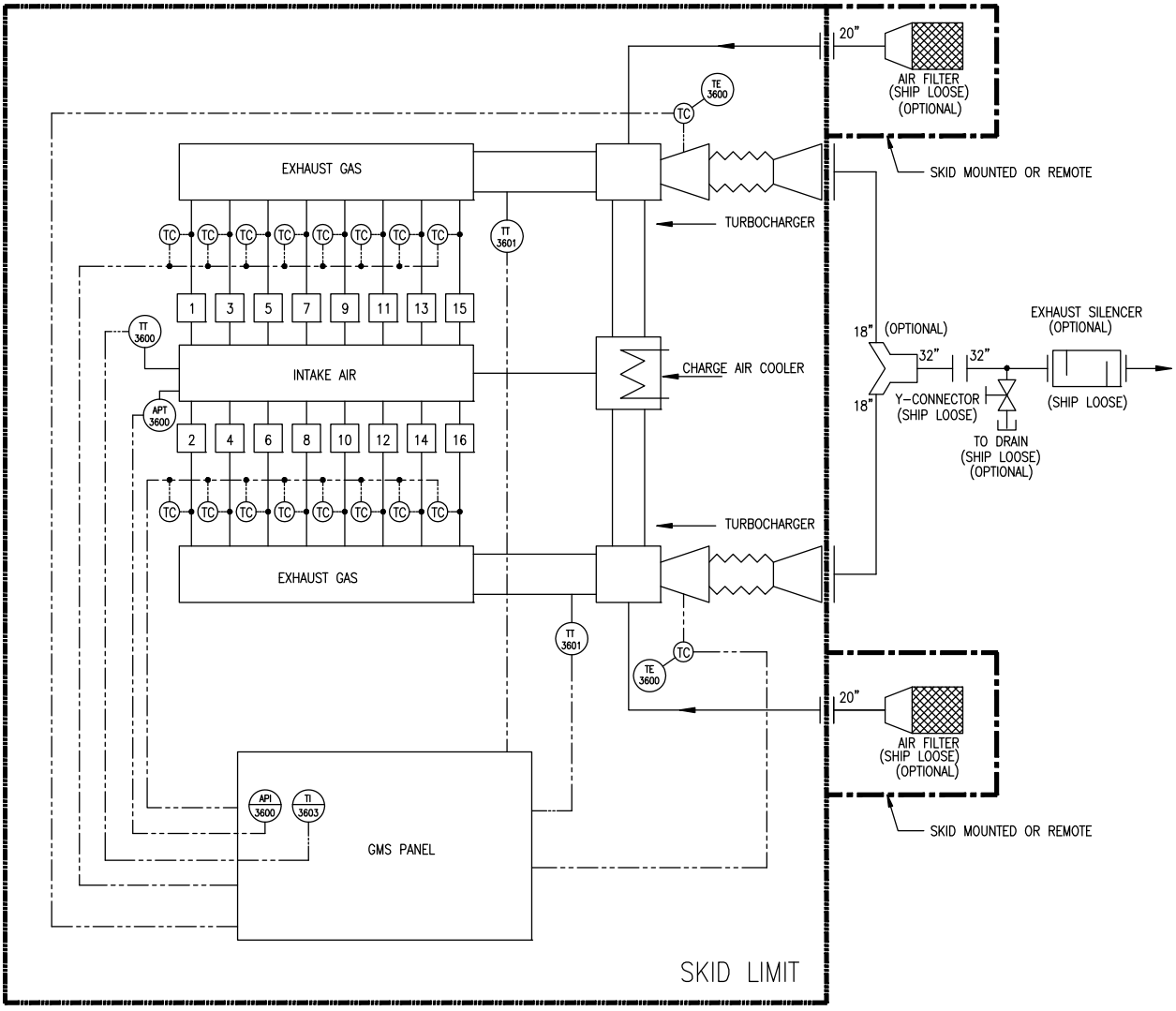
Combustion Air Piping System

A typical combustion air piping system is illustrated below.



NOTE: ALL ITEMS OUTSIDE SKID LIMIT ARE NOT DEALER SCOPE OF SUPPLY UNLESS OTHERWISE STATED.

LEGEND	DESCRIPTION
	EXHAUST GAS SILENCER
	FLEXIBLE FITTING
TC	THERMOCOUPLE
	PROCESS LINE
	ELECTRICAL SIGNAL
	SKID LIMIT
	GATE VALVE
	OPTIONAL SKID LIMIT

TAG No.	DESCRIPTION
APT 3600	INLET AIR MANIFOLD PRESSURE TRANSMITTER
TE 3600	EXHAUST STACK TEMPERATURE THERMOCOUPLE
TT 3600	INLET AIR MANIFOLD BOOST TEMPERATURE TRANSMITTER
TT 3601	EXHAUST TEMPERATURE INLET TO TURBO

METRIC

	1E2733	DRAWING – AUTOCAD
	1E0013Y	CONFIDENTIALITY
NOTE	1E0011	INTPR & TOL
	Caterpillar: Confidential Yellow	
CUSTOM PROD.	X	ENGINE MODEL: C280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		SCALE 1 = 20
THIRD ANGLE PROJECTION		SHEET 3 OF 5
		DWG CONTROL W118

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CUSTOMER:	MARKETING GUIDE
END USER:	
PROJECT:	C280
TITLE:	P&ID– AIR INTAKE–EXHAUST
309–4954	VER – CHG 00 D

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Engine Room Ventilation

General

Although not part of the Caterpillar Scope of Supply for a typical diesel generator package, the engine room ventilation system is a vital part of a successful installation. The two primary aspects of a properly designed engine room ventilation system addressed in this document are cooling air and combustion air.

- Cooling Air: The flow of air required to carry away the radiated heat of the engine(s) and other engine room machinery.
- Combustion Air: The flow of air required to burn the fuel in the engine(s).

Both of these have a direct impact on engine or packaged unit performance, and must be considered in the design of an engine room ventilation system. However, it is important to note that all equipment within the engine room space, not only the diesel generator packages, must be given consideration in the overall ventilation system design process.

Sizing Considerations

Cooling Air

Engine room ventilation air (cooling air) has two basic purposes:

- To provide an environment that permits the machinery and equipment to function properly with dependable service life.
- To provide an environment in which personnel can work comfortably.

A small percentage of fuel consumed by an engine is lost to the environment in the form of heat radiated to the surrounding air. In addition, heat from generator inefficiencies and exhaust piping can easily equal engine radiated heat. Any resulting elevated temperatures in the engine room may adversely affect maintenance, personnel, switchgear, and engine or generator set performance. The use of insulated exhaust pipes, silencer, and jacket water pipes will reduce the amount of heat radiated by auxiliary sources.

Radiated heat from the engines and other machinery in the engine room is absorbed by engine room surfaces. Some of the heat is transferred to atmosphere, but the remaining radiated heat must be carried away by the ventilation system.

A system for exhausting ventilation air from the engine room must be included in the ventilation system design. The engine(s) will not be able to carry all of the heated ventilation air from the engine room by way of the exhaust piping.

Combustion Air

In many installations, combustion air is drawn from outside of the engine room via ductwork, in which case, the combustion air is not a factor in the ventilation system design calculations. However, many installations require that combustion air be drawn directly from the engine room. In these installations, combustion air requirements become a significant ventilation system design parameter. Engine specific combustion air requirements can be found in the Technical Data section for the specific engine and rating.

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Ventilation Air Flow

Required ventilation air flow depends on the desired engine room air temperature as well as the cooling air and combustion air requirements outlined above. While it is understood that total engine room ventilation air flow must take all equipment and machinery into account, the following sections provide a means for estimating the air flow required for the successful operation of Caterpillar engines and packages.

In general, changing the air in the engine room every one or two minutes will be adequate, if flow routing is proper.

Provisions should be made by the installer to provide incoming ventilation air of 0.1 to 0.2 m^3/min (4 to 8 cfm) per installed horsepower. This does not include combustion air for the engines.

Engine Room Temperature

A properly designed engine room ventilation system will maintain engine room air temperatures within 8.5 to 12.5°C (15 to 22.5°F) above the ambient air temperature (ambient air temperature refers to the air temperature surrounding the power plant, vessel, etc.). Maximum engine room temperatures should not exceed 49°C (120°F). If they do, then outside air should be ducted directly to the engine air cleaners. The primary reason for cooling an engine room is to protect various components from excessive temperatures. Items that require cool air are:

- Electrical and electronic components
- Air cleaner inlets
- Torsional dampers
- Generators or other driven equipment
- Engine room for the engine operator or service personnel.

In larger multiple engine sites, the normal 8.5 to 12.5 °C (15 to 22.5 °F) temperature rise guidelines for engine rooms may require unobtainable or uncomfortable air velocities. For these larger sites, a ventilation system that gives priority to the five items listed above and provides a bottom to top air flow can be designed for a temperature rise of 17° C (30° F).

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Radiant Heat

Engine Radiant Heat

Engine generated heat must be taken into consideration. This information can be found on the Engine Technical Data Sheets.

Generator Radiant Heat

For generator set installations, the heat radiated by the generator can be estimated by the following formulas:

$$HRG\ (kW) = \frac{1}{P \times [EFF - 1]}$$

$$HRG\ (Btu/min) = P \times [EFF - 1] \times 56.9$$

Where:

HRG = Heat Radiated by the Generator (kW), (Btu/min)

P = Generator Output at Maximum Engine Rating (ekW)

Eff = Generator Efficiency %/100%
(Example: Eff = 94%/100% = 0.94)

Example:

A C280-16, 4840 ekW generator set has a generator efficiency of 95%. What is the generator radiant heat for this genset?

Solution:

P = 4840 ekW

$$Efficiency = \frac{95\%}{100\%} = 0.95$$

HRG = 4840 x (1 – 0.95)

HRG = 242 kW

HRG = 4840 x (1 – 0.95) x 56.9

HRG = 13,770 Btu/min

Calculating Required Ventilation Air Flow

Engine room ventilation air required for Caterpillar engines and packages can be estimated by the following formula, assuming 38°C (100°F) ambient air temperature.

$$V = \frac{H}{D \times CP \times \Delta T} + Combustion\ Air$$

Where:

V = Ventilating Air (m^3/min), (cfm)

H = Heat Radiation i.e. engine, generator, aux (kW), (Btu/min)

D = Density of Air at 38°C (100°F) (1.099 kg/m^3), (0.071 lb/ft^3)

Cp = Specific Heat of Air (0.017 kW x min/kg x °C), (0.24 Btu/°F)

ΔT = Permissible temperature rise in engine room (°C), (°F)

Note: If duct work is used to bring in air for the engine combustion air, the last term in the equation can be dropped.

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Example:
A C280-16, 4840 ekW genset has the following data:

Heat rejection: 242 kW (13,770 Btu/min)

Temperature rise: 11°C (20°F)

Solution:
The estimated engine room ventilation required for this arrangement:

$$V = \frac{242}{1.099 \times 0.017 \times 11} = 1178\ m^3/min$$

$$V = \frac{13770}{0.071 \times 0.24 \times 20} = 40{,}400\ cfm$$

Ventilation Fans

In modern installations, except for special applications, natural draft ventilation is too bulky for practical consideration. Adequate quantities of fresh air are best supplied by powered (fan-assisted) ventilation systems.

Fan Location

Fans are most effective when they withdraw ventilation air from the engine room and exhaust the hot air to the atmosphere. However, ideal engine room ventilation systems will utilize both supply and exhaust fans. This will allow the system designer the maximum amount of control over ventilation air distribution.

Fan Type

Ventilation fans are typically of the vane-axial, tube-axial or propeller type, or the centrifugal type (squirrel cage blowers). The selection of fan type is usually determined by ventilation air volume and pressure requirements, and also by space limitations within the engine room. When mounting exhaust fans in ventilation air discharge ducts, which is the most effective location, the fan motors should be mounted outside the direct flow of hot ventilating air for longest motor life. The design of centrifugal fans (squirrel cage blowers) is ideal in this regard, but their size, relative to the vane-axial or tube-axial fans, sometimes puts them at a disadvantage.

Fan Sizing

Fan sizing involves much more than just selecting a fan that will deliver the air flow volume needed to meet the cooling air and combustion air requirements determined earlier in this section. It requires a basic understanding of fan performance characteristics and ventilation system design parameters.

Similar to a centrifugal pump, a fan operates along a specific fan curve that relates a fan's volume flow rate (m^3/min or cfm) to pressure rise (mm H_2O or in. H_2O) at a constant fan speed. Therefore, fan selection not only requires that the volume flow rate be known, but also that the ventilation distribution system be known in order to estimate the system pressure rise. This information allows the optimum fan to be selected from a set of manufacturers' fan curves or tables.

Exhaust Fans

Ventilation air exhaust systems should be designed to maintain a slight positive or negative pressure in the engine room, depending on the specific application.

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Generally, maintaining a slight positive pressure in the engine room is recommended, but should normally not exceed 5 mm H_2O (0.2 in. H_2O). This positive pressure accomplishes several things:

- It prevents the ingress of dust and dirt, which is especially beneficial for those applications involving engines that draw their combustion air from the engine room.
- It creates an out draft to expel heat and odor from the engine room.

Some applications require that a slight negative pressure be maintained in the engine room, but normally not in excess of 12.7 mm H_2O (0.5 in. H_2O). The excess exhaust ventilation air accomplishes several things:

- It compensates for the thermal expansion of incoming air.
- It creates an in draft to confine heat and odor to the engine room.

Two Speed Fan Motors

Operation in extreme cold weather may require reducing ventilation airflow to avoid uncomfortably cold working conditions in the engine room. This can be easily done by providing ventilation fans with two speed (100% and 50% or 67% speeds) motors.

Routing Considerations

Correct Ventilation Air Routing is Vital for creating and maintaining the optimum engine room environment required to properly support the operation of Caterpillar engines and packaged units. Maintaining recommended air temperatures in the engine room is impossible without proper routing of the ventilation air.

Fresh air inlets should be located as far from the sources of heat as practical and as high as possible; and since heat causes air to rise, it should be exhausted from the engine room at the highest point possible, preferably directly over the engine. Where possible, individual exhaust suction points should be located directly above the primary heat sources in order to remove the heat before it has a chance to mix with engine room air and raise the average temperature. However, it must be noted that this practice will also require that ventilation supply air be properly distributed around the primary heat sources. Avoid ventilation air supply ducts that blow cool air directly toward hot engine components. This mixes the hottest air in the engine room with incoming cool air, raising the temperature of all the air in the engine room, and leaves areas of the engine room with no appreciable ventilation.

For offshore applications, where the potential exists for sea water to be drawn into the ventilation air supply, the combustion air should be delivered in a manner that will preclude any sea water from being ingested by the turbochargers through the air intake filters.

These general routing principles, while driven by the same basic principles of heat transfer, will vary with the specific application. This section discusses the general considerations relating to 1 and 2 engine applications, multiple engine (3+) applications, and several special applications.

1 and 2 Engine Applications

These applications will generally require smaller engine rooms, which may sometimes preclude the use of good routing practices.

Recommended ventilation systems for these applications, presented in order of preference, are described below and illustrated in **Figure 2** and **Figure 3**.

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Ventilation Type 1

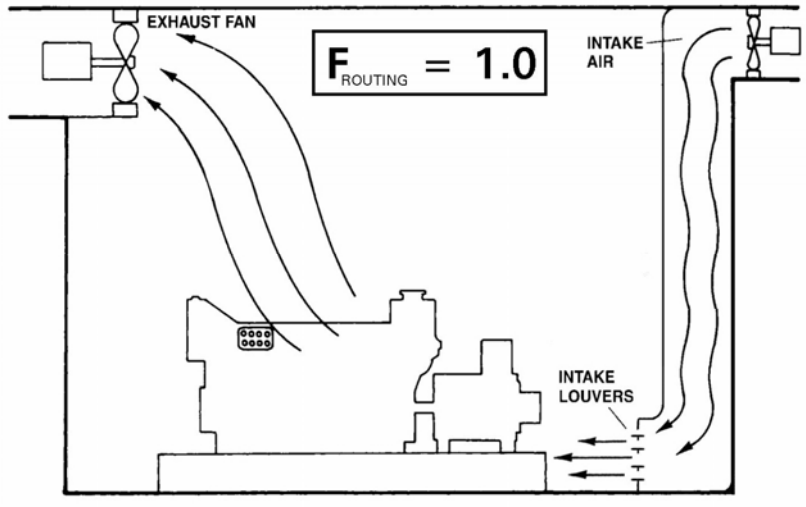

Figure 2

Ventilation Types 1 and 2 (Preferred Design)

Outside air is brought into the engine room through a system of ducts. These ducts should be routed between engines, at floor level, and discharge air up at the engines and generators. The most economical method is to use a service platform, built up around the engines, to function as the top of this duct. See **Figure 5**.

Ventilation Type 2

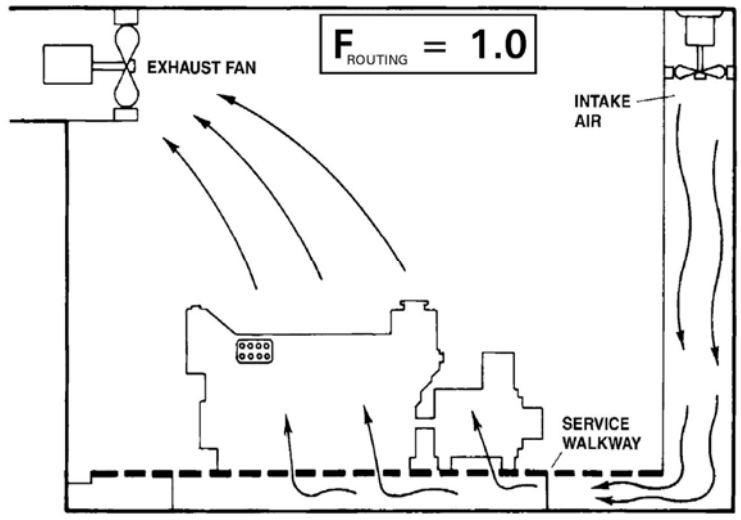

Figure 3

This requires the service platform to be constructed of solid, nonskid plate rather than perforated or expanded grating. The duct outlet will be the clearance between the decking and oilfield base.

Ventilation air exhaust fans should be mounted or ducted at the highest point in the engine room. They should be directly over heat sources.

This system provides the best ventilation with the least amount of air required. In addition, the upward flow of air around the engine serves as a shield which minimizes the amount of heat released into the engine room. Air temperature in the exhaust air duct will be higher than engine room air temperature.

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Ventilation Type 3 (Alternate Design)

If Ventilation Type 1 is not feasible, the following method is recommended; however, it will require approximately 50% more air flow.

Ventilation Type 3

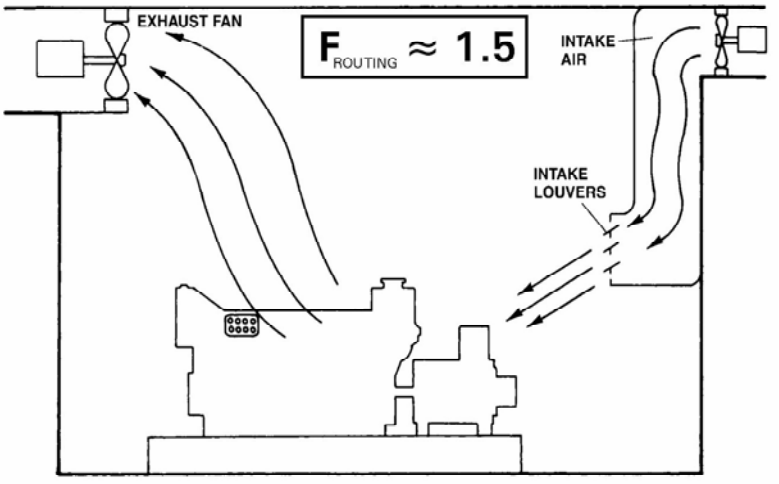

Figure 4

Outside air is brought into the engine room as far away as practical from heat sources, utilizing fans or large intake ducts. The air is discharged into the engine room as low as possible as illustrated in **Figure 4**. Allow air to flow across the engine room from the cool air entry point(s) toward sources of engine heat such as the engine, exposed exhaust components, generators, or other large sources of heat.

Ventilation air exhaust fans should be mounted or ducted at the highest point in the engine room. Preferably, they should be directly over heat sources.

Engine heat will be dissipated with this system, but a certain amount of heat will still radiate and heat up all adjacent engine room surfaces.

If the air is not properly routed, it will rise to the ceiling before it gets to the engines.

This system will work only where the air inlets circulate the air between the engines, for 2 engine applications. Air inlets located at the end of the engine room will provide adequate ventilation to only the engine closest to the inlet.

Ventilation Type 4 (Alternate Design)

If Ventilation Types 1 and 2 are not feasible, the following method can be used; however, it provides the least efficient ventilation and requires approximately 2.5 times the air flow of Ventilation Types 1 and 2.

Outside air is brought into the engine room using supply fans, and discharged toward the turbocharger air inlets on the engines as illustrated in **Figure 5**.

Ventilation exhaust fans should be mounted or ducted from the corners of the engine room.

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Ventilation Type 4

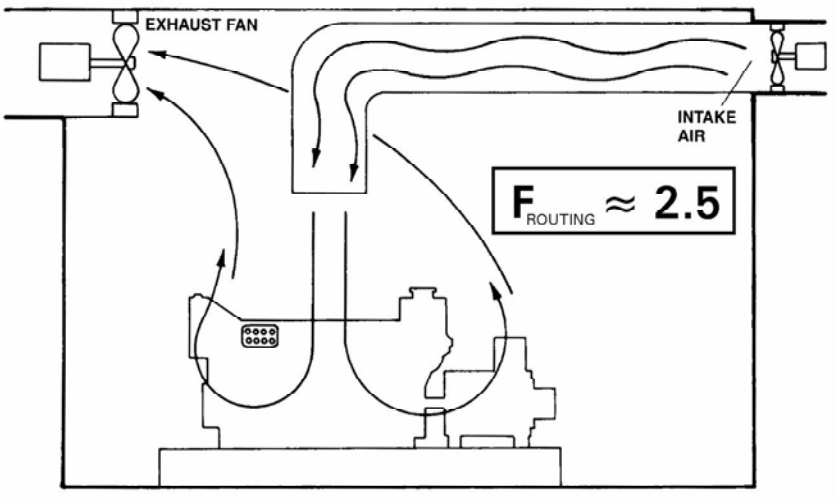

Figure 5

This system mixes the hottest air in the engine room with the incoming cool air, raising the temperature of all air in the engine room. It also interferes with the natural convection flow of hot air rising to exhaust fans. Engine rooms can be ventilated this way, but it requires extra large capacity ventilating fans.

Multiple Engine (3+) Applications

Multiple engine applications, involving three or more engines or packaged units, will generally require larger engine rooms than those needed for 1 and 2 engine applications.

In general, the recommended ventilation systems outlined for 1 and 2 engine applications also apply to multiple engine applications. However, there are several additional considerations that are specific to multiple engines.

As previously mentioned, the application of normal temperature rise guidelines for determining large multiple engine site ventilation requirements will generally result in extremely large volumes of air. Therefore, the guidelines used for these sites are significantly more generous; however, even with the increased temperature rise allowed, the ventilation requirements will be significant. Large multiple engine sites will generally utilize multiple ventilation fans, often using one or two fans for each engine. This practice allows for a very simple arrangement requiring minimal ductwork.

The use of multiple ventilation fans, either supply or exhaust, will require that air flow between the engines be arranged, either by fan placement or by distribution ductwork. **Figure 6** and **Figure 7** show examples of correct and incorrect air flow patterns for multiple engine sites.

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Correct Air Flow

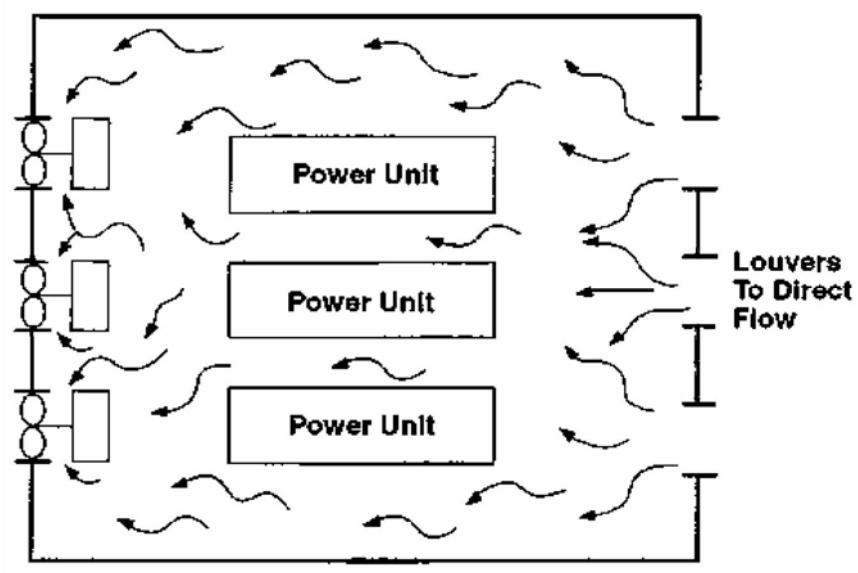

Figure 6

Incorrect Air Flow

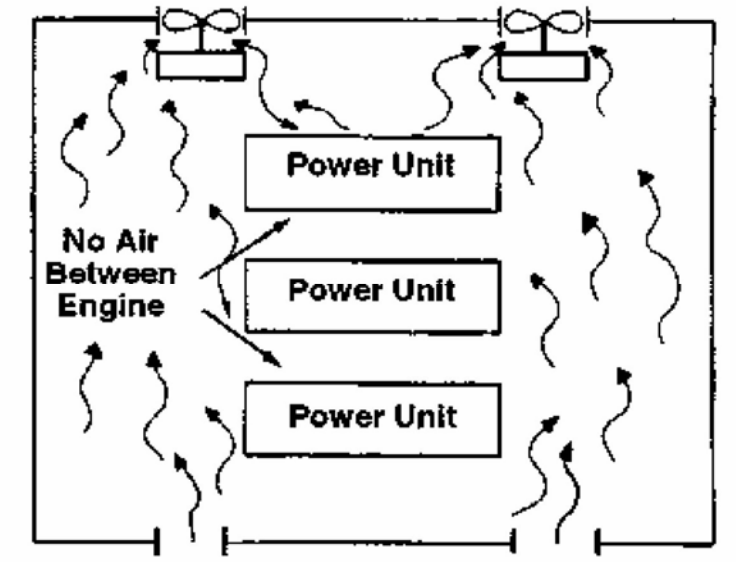

Figure 7

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Exhaust System

General

The C280/3600 engine uses a pulse exhaust manifold system. The front and rear three cylinders are connected to separate turbine inlets.

Exhaust System Design Considerations

Exhaust Backpressure Limits

The total C280/3600 exhaust backpressure limit is 254 mm H_2O. This level was established with an emphasis on low specific fuel consumption and exhaust valve temperatures. Therefore, to achieve proper performance of the engine, the exhaust backpressures must be kept below this limit.

System backpressure should be measured in a straight length of the exhaust pipe at least 3 to 5 pipe diameters away from the last size transition from the turbocharger outlet. System backpressure measurement is part of the engine commissioning.

Turbochargers

For the single turbocharger 6 cylinder engine and the two turbocharger 12 cylinder engine, the turbochargers are located at the flywheel end of the engine. The turbocharger exhaust outlet is rectangular with an area equivalent to 311 mm (12 in.) diameter. A cast adapter mounts to each turbocharger to provide a 355 mm (14 in.) diameter customer connection point. Optional attachments for these turbochargers include 355 mm (14 in.) diameter flexible bellows, expansion transitions from 355 mm (14 in.) to 457 mm (18 in.) diameter, 457 mm (18 in.) diameter bellows, and exhaust flanges with bolting and mounting hardware.

For the single turbocharger 8-cylinder engine and the two turbocharger 16-cylinder engine, the turbochargers are located at the flywheel end of the engine. The turbocharger exhaust outlet is 355 mm (14 in.) diameter with cast adaptors mounted to each turbocharger to provide a 457 mm (18 in.) diameter customer connection point. Optional attachments for these turbochargers include 355 mm (14 in.) diameter flexible bellows, 457 mm (18 in.) diameter bellows, and exhaust flanges with bolting and mounting hardware.

Additionally, there is an optional two turbocharger 16-cylinder engine with the turbochargers mounted opposite the flywheel end of the engine for a front mounted turbo engine configuration. This engine includes the same cast adaptors and options as the previously mentioned rear mounted turbo engine configuration.

The exhaust bellows are intended to compensate for thermal growth and movement of the engine. The exhaust system structure immediately after the engine exhaust bellows must be a fixed, rigid point. The supplied exhaust bellows will only handle the engine movement and thermal growth. No additional external loading is allowed on the turbochargers.

Exhaust Slobber (Extended Periods of Low Load)

Prolonged low load operation should be followed by periodic operation at higher load to burn out exhaust deposits. Low load operation is below 400 kPa bmep (58 psi bmep) (approximately 20% load, depending on rating). The engine should be operated above 800 kPa bmep (116 psi bmep) (about 40% load, depending on rating) periodically to burn out the exhaust deposits. The 3600/C280 engine can be run well over 24 hours

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before exhaust slobber becomes significant. The amount of additional time depends upon the engine configuration, water temperature to the aftercooler, inlet air temperature to the engine and type of fuel.

Exhaust Piping

A common exhaust system for multiple installations is not acceptable. An exhaust system combined with other engines allows operating engines to force exhaust gases into engines not operating. The water vapor condenses in the cold engines and may cause engine damage. Additionally, soot clogs turbochargers, aftercoolers, and cleaner elements. Valves separating engine exhaust systems are also discouraged. High temperatures warp valve seats and soot deposit causes leakage.

The exhaust pipe diameter is based on engine output, gas flow, and length of pipe and number of bends. The maximum gas velocity should not exceed 50 m/s (164 ft/sec) at full load. Sharp bends should be avoided, and where necessary, should have the largest possible radius. The minimum radius should be 1½ pipe diameters. The piping should be as short as possible and insulated. The insulation should be protected by mechanical lagging to keep it intact. All flexible exhaust fittings should be insulated using removable quilted blankets. It is recommended to provide the system with a valve drain arrangement to prevent rainwater from entering the engine during prolonged shutdown periods. For testing purposes, the exhaust system must have a test port installed after the turbocharger outlet. This test port should be a 10 to 13 mm (0.39 to 0.51 in.) plugged pipe welded to the exhaust piping and of sufficient length to bring it to the outer surface of the insulated piping.

Exhaust piping must be able to expand and contract. It is required that one fixed point be installed directly after the flexible exhaust fitting at the turbocharger outlet. This will prevent the transmission of forces resulting from weight, thermal expansion or lateral displacement of the external exhaust piping from acting on the turbocharger.

Engine Piping Connections

For the single turbocharger 6 cylinder engine and the two turbocharger 12 cylinder engine, the turbocharger exhaust outlet is rectangular with an area equivalent to 311 mm (12 in.) diameter.

For the single turbocharger 8-cylinder engine and the two turbocharger 16-cylinder engine, the turbocharger exhaust outlet is 355 mm (14 in.) diameter with cast adaptors mounted to each turbocharger to provide a 457 mm (18 in.) diameter customer connection point.

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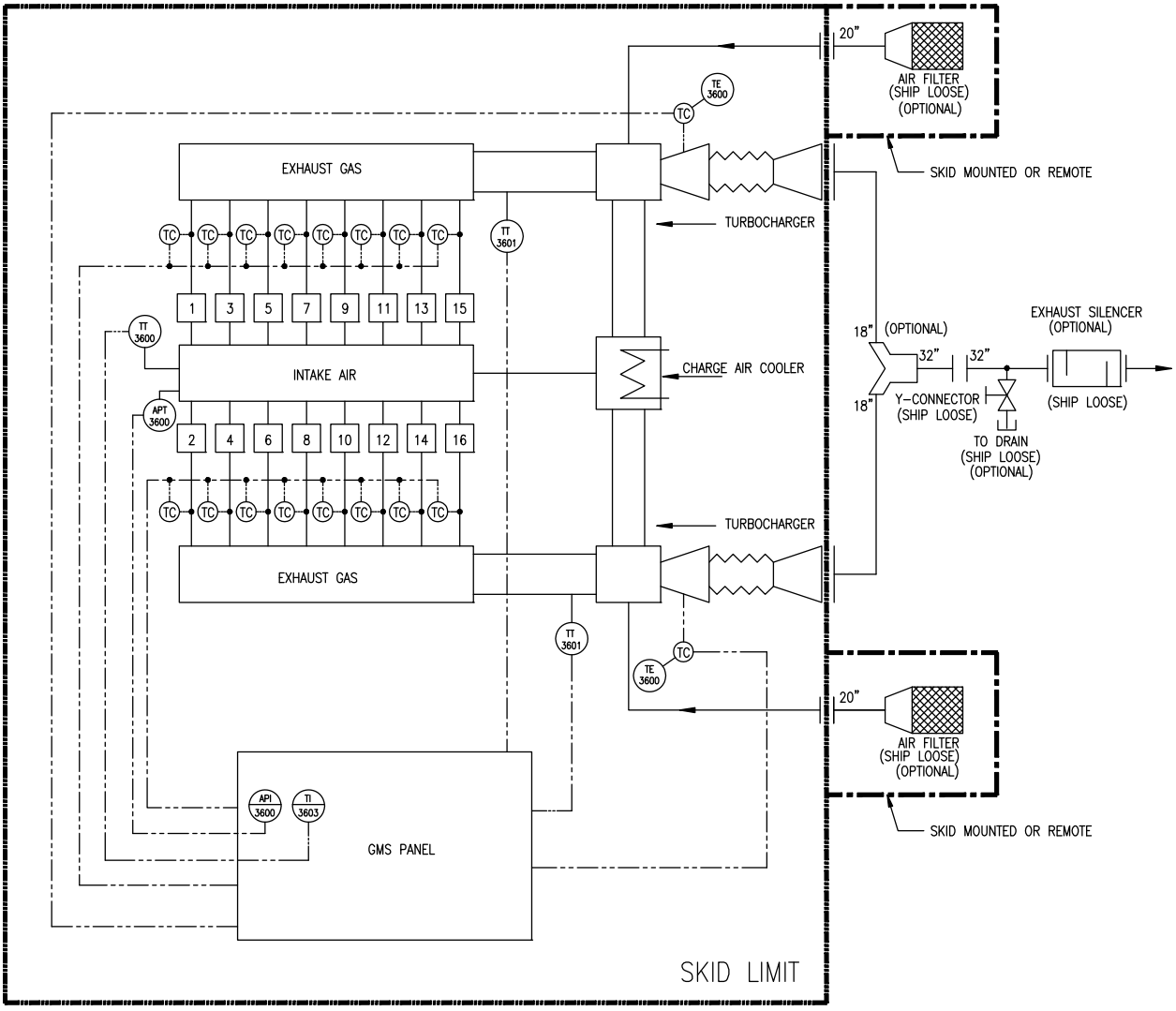
Exhaust Gas Piping System

A typical exhaust system arrangement is shown below.



NOTE: ALL ITEMS OUTSIDE SKID LIMIT ARE NOT DEALER SCOPE OF SUPPLY UNLESS OTHERWISE STATED.

LEGEND	DESCRIPTION
	EXHAUST GAS SILENCER
	FLEXIBLE FITTING
TC	THERMOCOUPLE
	PROCESS LINE
	ELECTRICAL SIGNAL
	SKID LIMIT
	GATE VALVE
	OPTIONAL SKID LIMIT

TAG No.	DESCRIPTION
APT 3600	INLET AIR MANIFOLD PRESSURE TRANSMITTER
TE 3600	EXHAUST STACK TEMPERATURE THERMOCOUPLE
TT 3600	INLET AIR MANIFOLD BOOST TEMPERATURE TRANSMITTER
TT 3601	EXHAUST TEMPERATURE INLET TO TURBO

METRIC

	1E2733	DRAWING – AUTOCAD
	1E0013Y	CONFIDENTIALITY
NOTE	1E0011	INTPR & TOL
	Caterpillar: Confidential Yellow	
CUSTOM PROD.	X	ENGINE MODEL: C280
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		SCALE 1 = 20
THIRD ANGLE PROJECTION		SHEET 3 OF 5
		DWG CONTROL W118

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CUSTOMER:	MARKETING GUIDE
END USER:	
PROJECT:	C280
TITLE:	P&ID– AIR INTAKE–EXHAUST
309–4954	VER – CHG 00 D

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Engine Governing and Control System

Introduction

This section and the following section describe the standard Caterpillar GMS control and governor arrangement. The standard control system offering is a PLC based control and monitoring system with a relay based backup safety shutdown system. The system is capable of communicating with the vessel main control system through various communication protocols.

Generator Engine Governing System

C280

- ADEM III
- Optional Direct Rack (PLC required)

Note: Direct Rack is mutually exclusive with the load sharing module.

3600

- Woodward
- Heinzmann

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Engine Monitoring and Shutdown

Engine Shutdown

The C280/3600 engine is installed with shutdown protection for overspeed, low lubrication oil pressure, high crankcase pressure, high jacket water temperature, and Metal Particle Detection. High oil mist level alarm and/or shutdown are available as an option to satisfy marine societies which typically require this feature on engines above 2250 bkW. In addition, the engine can be shutdown through the electrical control system via emergency shutdown buttons installed as required by the Marine Classification Society on the bridge and the engine control panel. For the shutdowns, the engine is stopped via the shutdown solenoid in the governor. However, in case of an overspeed or activated emergency stop button, the engine will be stopped by an emergency air shutoff system. Both of these measures are taken as a precaution and to fulfill society requirements.

The engine safety system is operationally independent from the monitoring system. That means the engine will shut down for the safety functions, high crankcase pressure, overspeed and low lubrication pressure even when the PLC is not operational.

Engine Monitoring

Engine monitoring switches and analog sensors (4-20 mA transmitters, RTD's, switches, and thermocouples) can vary from one installation to the next.

Pressure Sensors

The engine is installed with a sensor package in accordance with the sensor list enclosed. The pressure sensors are generally mounted on a common panel on either the front or side of the engine.

Temperature Sensors

The exhaust temperature sensors are thermocouples and the remaining sensors are RTD's (PT100).

Engine Control Panel

The Engine Control Panel contains the PLC, start / stop logic and man-machine interface (MMI) touch screen for displaying the operating parameters. The operator is able to view engine parameters from different screens for each system (exhaust, water, and air) on the engine. The various screens are called to view by buttons located at the bottom of each screen. All the engine parameters are further available to the vessel control system via P/C communications.

The monitoring and alarm functions listed in the instrumentation list overleaf are typical for a C280/3600 Marine engine supply, Marine Classification Society with notation: Unmanned Machinery Space (UMS).

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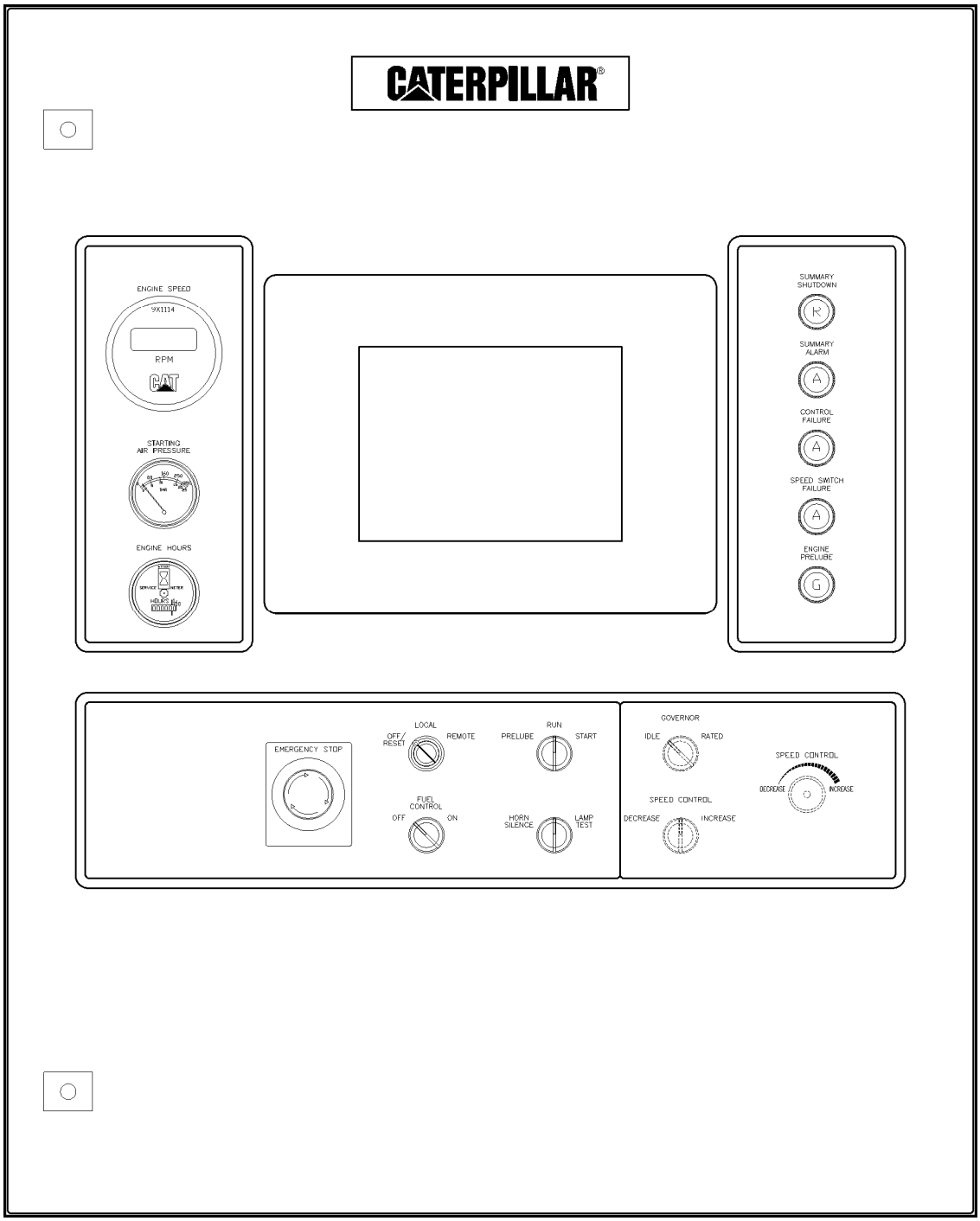
Control and Monitoring System Diagram

The standard drawings consist of approximately 24 pages. A few pages are shown to describe the layout. The following drawings and sensor list are for reference only, and are not to be used for installation purposes.



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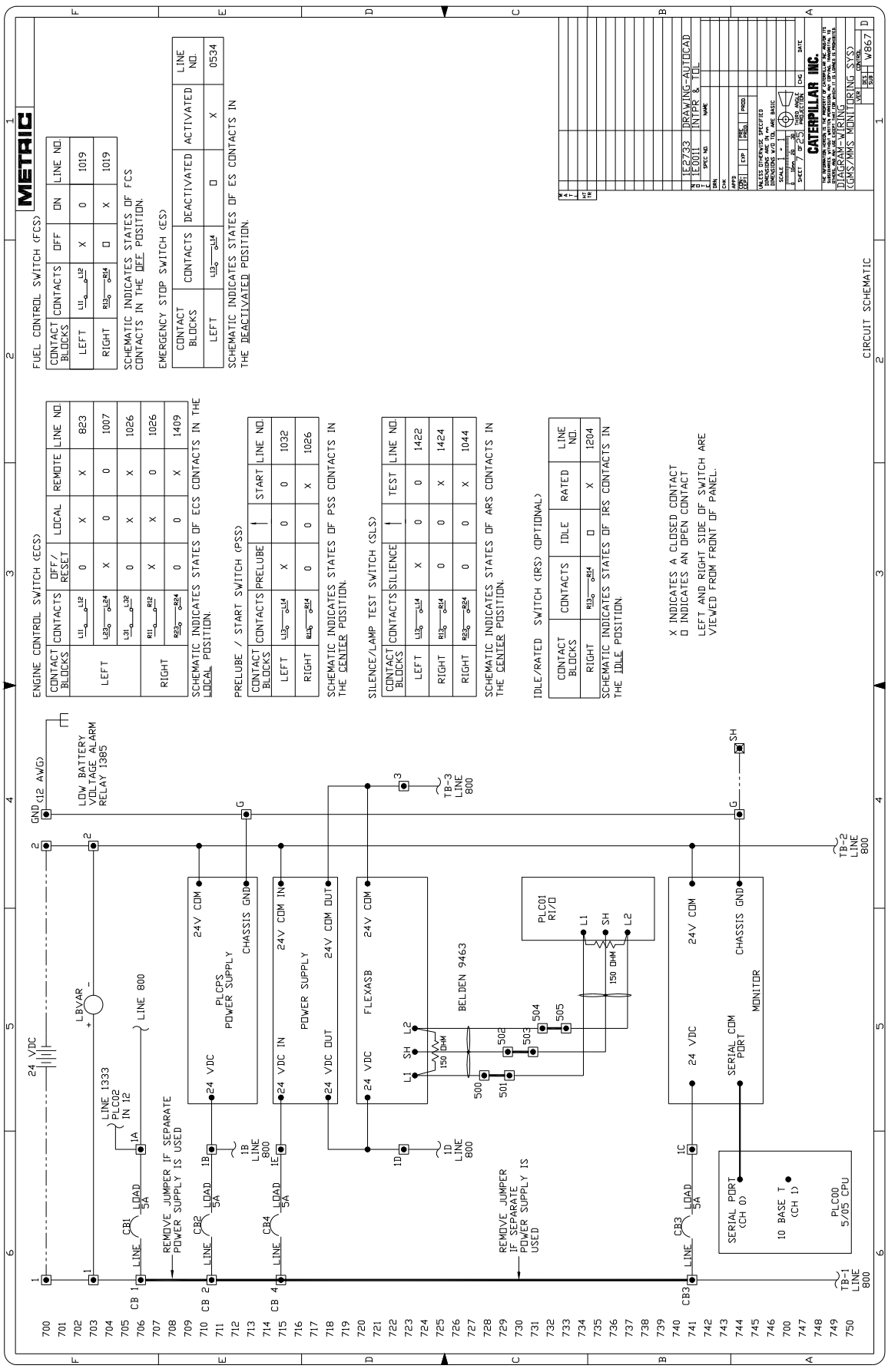

ENGINE MONITORING AND SHUTDOWN

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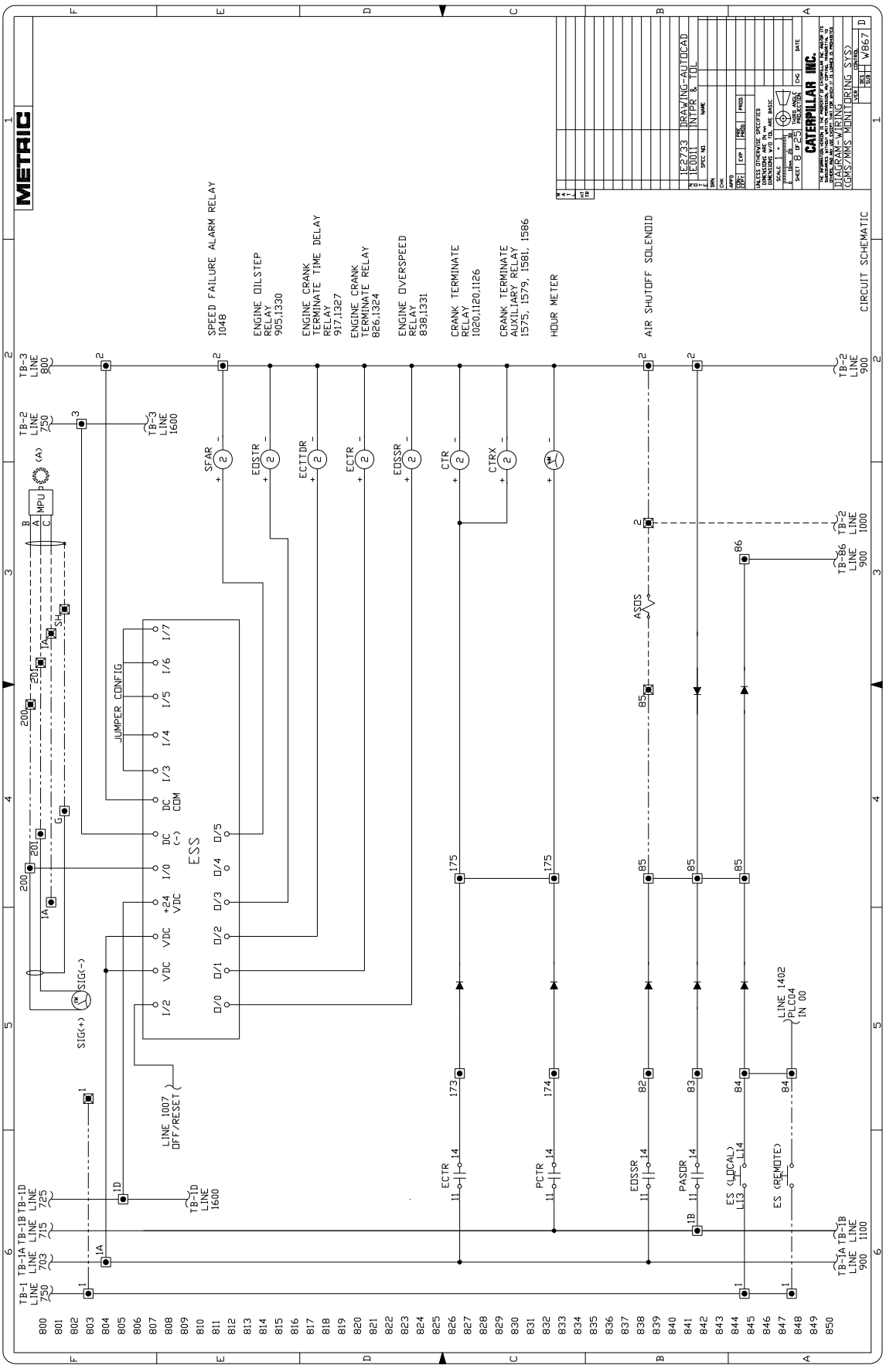

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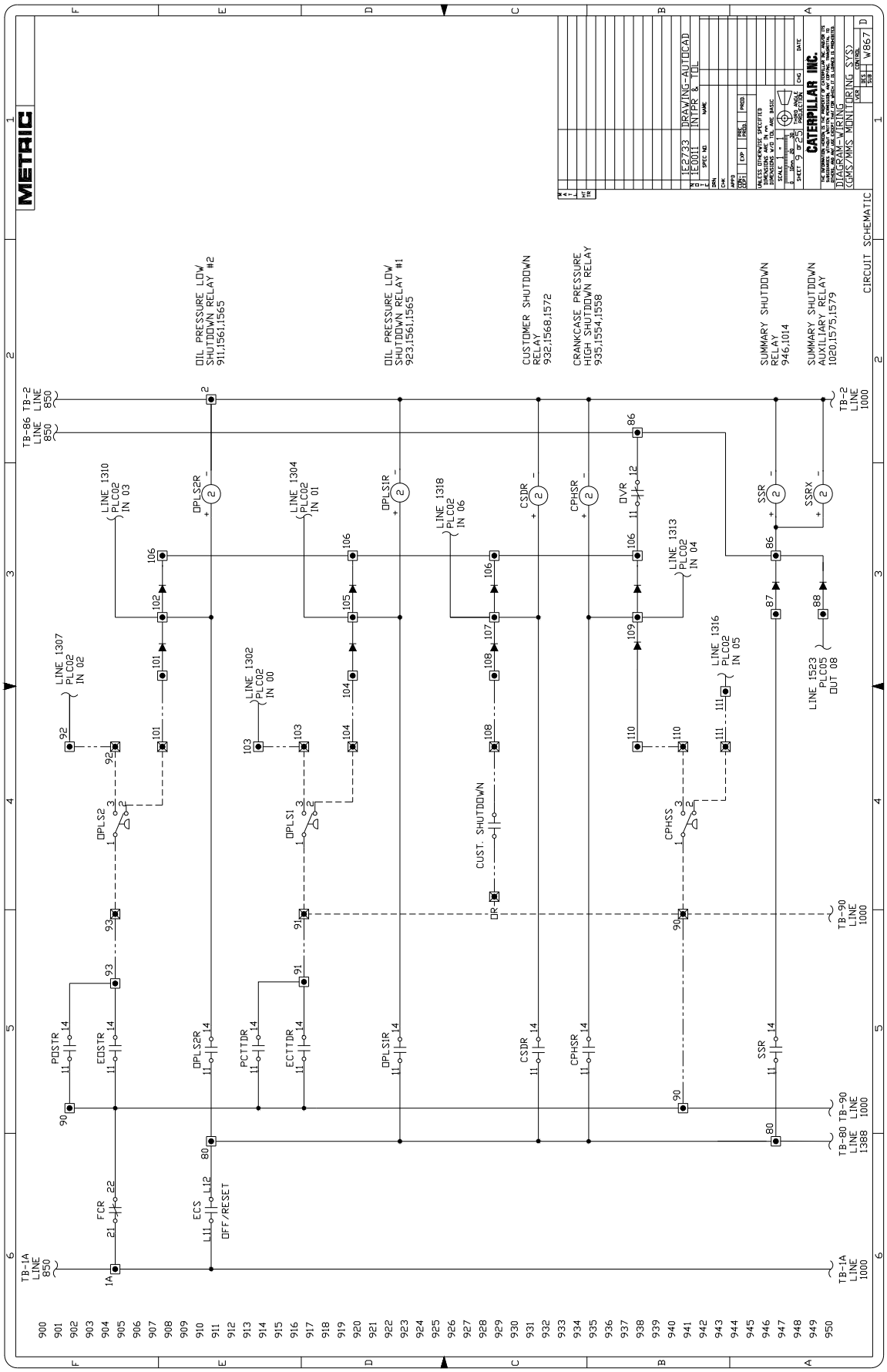

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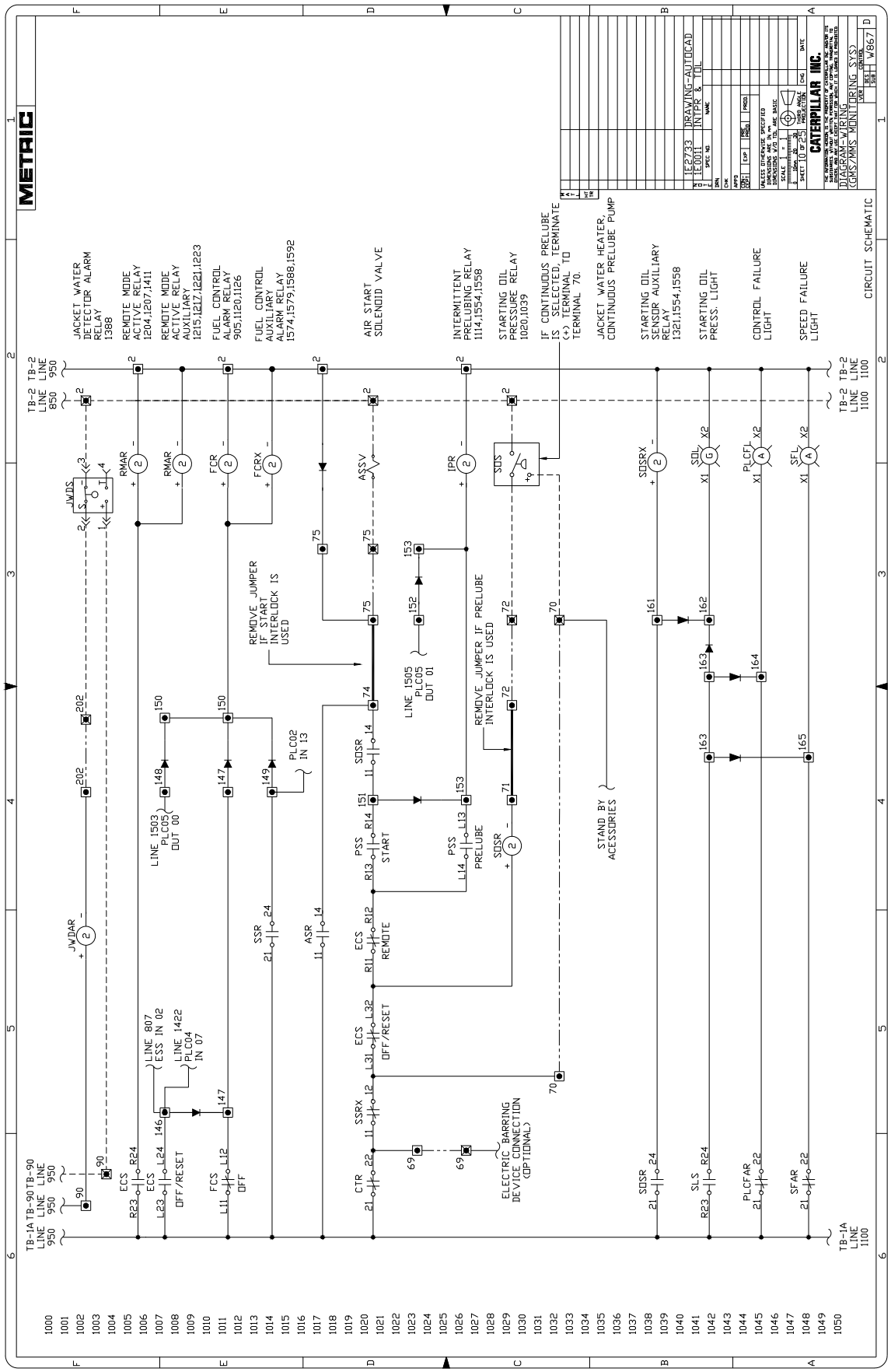

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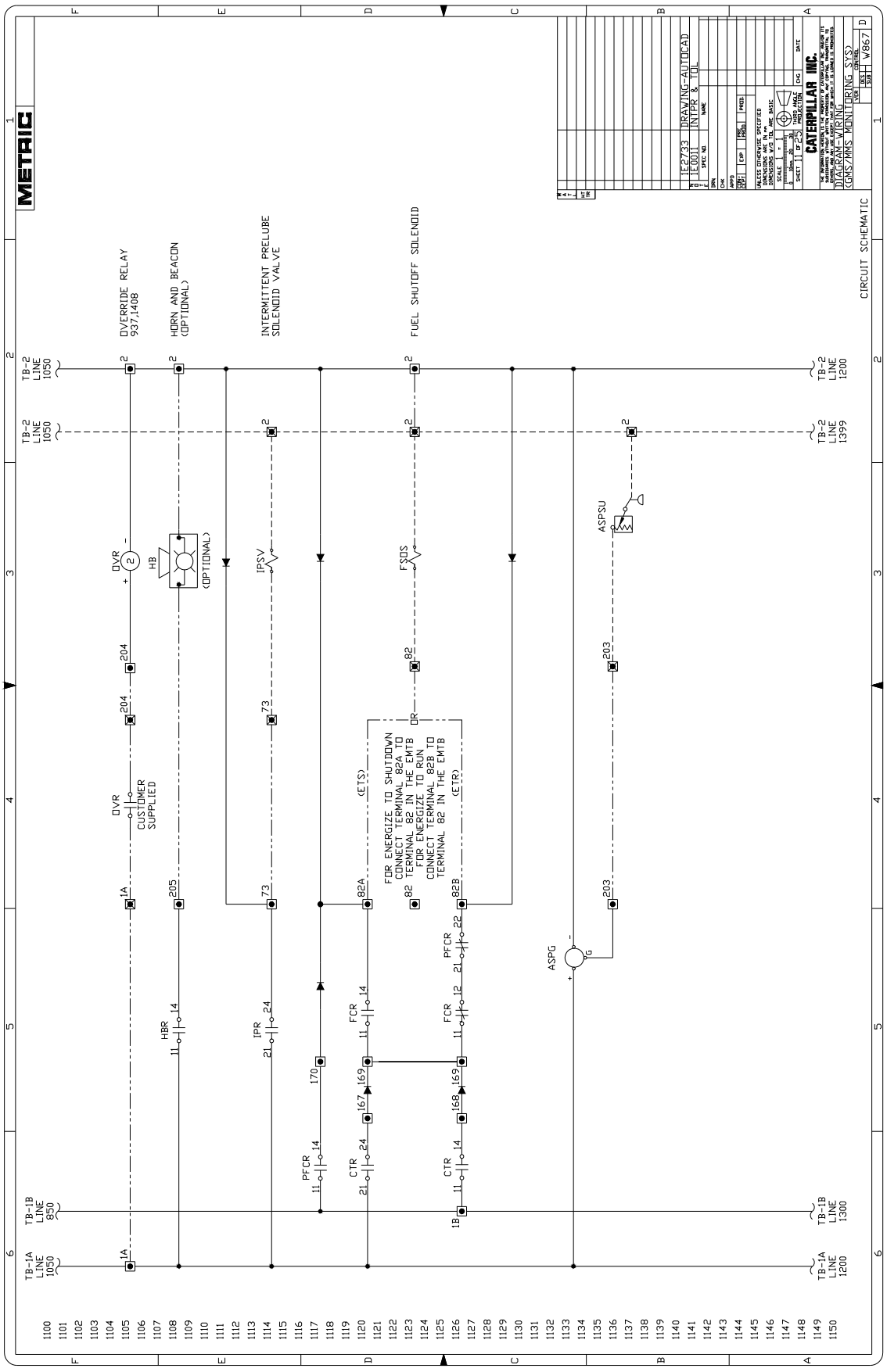

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Control System Inputs to PLC and Redundant Relay Logic

Ensure that all safety information, warnings, and instructions are read and understood before any operation or any maintenance procedures are performed.

Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
PRESSURE CONTACTORS					
ENGINE LOW OIL PRESSURE: 144-0102	DIGITAL		X	< 105 kPa	LOW SPEED
ENGINE LOW OIL PRESSURE: 144-0102	DIGITAL		X	< 260 kPa	HIGH SPEED
ENGINE HIGH CRANKCASE PRESSURE: 117-1864	DIGITAL		X	> 1 kPa	ENABLE WHEN FUEL IS ON
LOW AIR STARTING PRESSURE: 144-0103	DIGITAL	X		< 750 kPa	REMOVED IF TRANSDUCER IS ORDERED
SEAWATER LOW PRESSURE:	DIGITAL	X		< 35 kPa	REMOVED IF TRANSDUCER IS ORDERED
LOW JACKET WATER PRESSURE: 144-0102	DIGITAL	X		< 20 kPa (LOW RPM) < 35 kPa (HIGH RPM)	REMOVED IF TRANSDUCER IS ORDERED
LOW AC/OC CIRCUIT WATER PRESSURE: 144-0102	DIGITAL	X		< 35 kPa	REMOVED IF TRANSDUCER IS ORDERED
SWITCHES/MISC CONTACTS					
LOW BATTERY VOLTAGE: 7C-3508	DIGITAL	X		< 22 VDC	MONITORS DC TO MMS
JACKET WATER DETECTION: 125-4340	DIGITAL	X		CONTACT CLOSE	ENERGIZES RJWDA RELAY
EMERGENCY STOP (LOCAL)	DIGITAL		X	CONTACT CLOSE	SHUTS OFF FUEL AND AIR TO ENGINE
ENGINE SPEED SWITCH CRANK TERMINATE: 100-5675	DIGITAL			> 170 RPM & < 0 + 2 SEC	
ENGINE SPEED SWITCH ALARM TIME DELAY: 100-5675	DIGITAL			9 SEC AFTER SS-001	ENABLES ALARMS AND SHUTDOWNS
ENGINE SPEED SWITCH OIL PRESSURE STEP: 100-5675	DIGITAL			75 % RATED SPEED	ENABLES HIGH SPEED OIL CONTACTOR
ENGINE OIL SUMP LEVEL LOW: 7C-6930	DIGITAL	X		CONTACT OPEN	
ENGINE PRE-LUBE PRESSURE: 3N-1400	DIGITAL			> 9 kPa	ENGINE START INTERLOCK
OIL MIST DETECTION (SYSTEM STATUS READY)	DIGITAL	X		CONTACT CLOSE	OIL MIST DETECTOR READY
OIL MIST DETECTION (ALARM)	DIGITAL	X		CONTACT OPEN	OIL MIST DETECTOR ALARM
EXPANSION TANK LOW LEVEL SWITCH	DIGITAL	X		CONTACT OPEN	CUSTOMER SUPPLIED
ENGINE OVERSPEED (ENGINE SPEED SWITCH): 100-5675	DIGITAL		X	113% RATED SPEED	PROVIDED BY SPEED SWITCH
FUEL CONTROL SWITCH	DIGITAL				RELAY BASED SYSTEM

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
PRELUBE/START SWITCH - START SIGNAL	DIGITAL				RELAY BASED SYSTEM
PRELUBE/START SWITCH - PRELUBE SIGNAL	DIGITAL				RELAY BASED SYSTEM
ENGINE CONTROL SWITCH - OFF/RESET	DIGITAL			CONTACT CLOSE	LOCK OUT ENGINE AND RESET SYSTEM
ALARM/SHUTDOWN ACKNOWLEDGE	DIGITAL			CONTACT CLOSE	INDICATES ACK ALARMS
METAL PARTICLE DETECTOR	DIGITAL	X	X	CONTACT CLOSE	SHUTDOWN
ANALOG SPEED & PRESSURE TRANSDUCER					
MAG PICK-UP (ENGINE SPEED SWITCH): 8L-4171	FREQ		X	113% RATED SPEED	SPEED SWITCH CONTROL SENSOR
MAG PICK-UP (PLC): 8L-4171	FREQ				INPUT TO ENGINE SPEED TRANSDUCER
ENGINE SPEED FROM SE-005: 115-7954	4-20mA		X	113% RATED SPEED	0-1200 RPM
LUBE OIL PRESSURE TO FILTER: 141-9880	4-20mA				0-1000 kPa USED TO CALCULATE OIL FILTER DIFF PRESS
LUBE OIL PRESSURE TO ENGINE: 141-9880	4-20mA	X		< 320 kPa & < 120 kPa	0-1000 kPa
			X	< 260 kPa & < 105 kPa	HIGH SPEED SETPNT & LOW SPEED SETPNT
FUEL PRESSURE TO FILTER: 141-9880	4-20mA				0-1000 kPa. USED FOR DIFF ALARM
FUEL PRESSURE TO ENGINE: 141-9880	4-20mA	X		< 260kPa	0-1000 kPa
ENGINE JACKET WATER PRESSURE: 141-9880	4-20mA	X		< 20 kPa (LOW RPM)	0-1000 kPa
				< 35 kPa (HIGH RPM)	OPTIONAL
AC/OC CIRCUIT WATER PRESSURE: 141-9880	4-20mA	X		< 35 kPa	0-1000 kPa. OPTIONAL
SEA WATER PRESSURE: 141-9880	4-20mA	X		< 35 kPa	0-1000 kPa. OPTIONAL
ENGINE STARTING AIR PRESSURE: 144-4003	4-20mA	X		< 750 kPa	0-4000 kPa. OPTIONAL
ENGINE STARTING AIR PRESSURE SENDING UNIT: 7W-2118	OHMS				SIGNAL FOR METER ON MMS
ENGINE INLET AIR MANIFOLD PRESSURE: 141-9880	4-20mA	X		> 310 kPa	0-1000 kPa
ANALOG RTD AND THERMOCOUPLE					
ENGINE LUBE OIL TEMPERATURE: 177-7245	RTD	X		> 92 C	PT100 – 385
INLET AIR MANIFOLD TEMPERATURE: 177-7245	RTD	X		> 92 C	PT100 – 385
ENGINE AC/OC CIRCUIT INLET WATER TEMP: 177-7245	RTD	X		> 60 C	PT100 – 385
ENGINE JACKET WATER OUTLET TEMP: 177-7245	RTD		X	> 109 C	PT100 – 385

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
ENGINE JACKET WATER OUTLET TEMP: 177-7245	RTD	X		> 103 C	PT100 - 385 2ND RTD PER MARINE SOCIETY
EXHAUST MANIFOLD TEMP. (LEFT): 124-4598	TC	X		> 630 C	TYPE K
EXHAUST MANIFOLD TEMP. (RIGHT): 124-4598	TC	X		> 630 C	TYPE K - 12 & 16 CYL ENGINE ONLY
EXHAUST STACK TURBO TEMP. (LEFT): 124-4598	TC	X		> 550 C	TYPE K
EXHAUST STACK TURBO TEMP. (RIGHT): 124-4598	TC	X		> 550 C	TYPE K - 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (1): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (2): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (3): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (4): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (5): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (6): 124-4596	TC	X		> 550 C	TYPE K
CYLINDER TEMPERATURE (7): 124-4596	TC	X		> 550 C	TYPE K - 8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (8): 124-4596	TC	X		> 550 C	TYPE K - 8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (9): 124-4596	TC	X		> 550 C	TYPE K - 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (10): 124-4596	TC	X		> 550 C	TYPE K - 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (11): 124-4596	TC	X		> 550 C	TYPE K - 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (12): 124-4596	TC	X		> 550 C	TYPE K - 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (13): 124-4596	TC	X		> 550 C	TYPE K - 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (14): 124-4596	TC	X		> 550 C	TYPE K - 16 CYL ENGINE ONLY
124-4596 CYLINDER TEMPERATURE (15):	TC	X		> 550 C	TYPE K - 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (16): 124-4596	TC	X		> 550 C	TYPE K - 16 CYL ENGINE ONLY
MARINE GEAR INPUTS					
GEAR LOW OIL PRESSURE SWITCH	DIGITAL		X	CUSTOMER SETPOINT	CUSTOMER SUPPLIED CONTACT
AUXILIARY INPUTS (ANALOG AND RTD)					
AUX RTD 1	RTD	X		CUSTOMER CONFIGURED	0-150 C. CUSTOMER SUPPLIED PT100 – 385

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
AUX RTD 2	RTD	X		CUSTOMER CONFIGURED	0-150 C. CUSTOMER SUPPLIED PT100 – 385
AUX 4-20 #1	4-20mA	X		CUSTOMER CONFIGURED	CUSTOMER SUPPLIED
AUX 4-20# 2	4-20mA	X		CUSTOMER CONFIGURED	CUSTOMER SUPPLIED
AUXILIARY INPUTS (SWITCHES)					
AUX SWITCH 1	DIGITAL	X		CONTACT CLOSE	CUSTOMER SUPPLIED CONTACT
REMOTE INPUT (CUSTOMER)					
REMOTE ENGINE START	DIGITAL			CONTACT CLOSE	CUSTOMER SUPPLIED CONTACT
REMOTE ENGINE STOP	DIGITAL			CONTACT CLOSE	CUSTOMER SUPPLIED CONTACT
REMOTE EMERGENCY STOP	DIGITAL			CONTACT CLOSE	CUSTOMER SUPPLIED CONTACT
ENGINE PROTECTION OVERRIDE	DIGITAL			CONTACT CLOSE	CUSTOMER SUPPLIED CONTACT
PRESSURE ALARMS/SHUTDOWNS					
ENGINE LOW OIL PRESSURE	BIT		X	105 kPa	LOW SPEED SHUTDOWN
ENGINE LOW OIL PRESSURE	BIT		X	260 kPa	HIGH SPEED SHUTDOWN
ENGINE LOW OIL PRESSURE	BIT	X		120 kPa / 320 kPa	LOW SPEED / HIGH SPEED
ENGINE HIGH CRANKCASE PRESSURE	BIT		X	> 1 kPa	
LOW AIR STARTING PRESSURE	BIT	X		< 750 kPa	
LOW SEAWATER PRESSURE	BIT	X		< 35 kPa	
LOW JACKET WATER PRESSURE	BIT	X		< 20 kPa (LOW RPM)	
				< 35 kPa (HIGH RPM)	
LOW AC/OC CIRCUIT WATER PRESSURE	BIT	X		< 35 kPa	
ENGINE OIL FILTER PRESSURE DIFFERENTIAL (HIGH)	BIT	X		> 70 kPa	CALC (PT-009 - PT-010)
ENGINE LOW FUEL PRESS. ALARM	BIT	X		< 260 kPa	
ENGINE FUEL FILTER PRESSURE DIFFERENTIAL (HIGH)	BIT	X		> 75 kPa	CALC(PT-011 - PT-012)
ENGINE INLET AIR MANIFOLD PRESSURE	BIT	X		> 230 kPa	
MARINE GEAR (PRESSURE SHUTDOWN)					
GEAR LOW OIL PRESSURE SWITCH	BIT		X	CUSTOMER DEFINED	CUSTOMER SUPPLIED CONTACT
TEMPERATURE (ALARM/SHUTDOWNS)					

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
ENGINE HIGH JACKET WATER	BIT		X	> 109 C	
ENGINE HIGH JACKET WATER	BIT	X		> 103 C	
ENGINE HIGH AC/OC CIRCUIT WATER TEMPERATURE	BIT	X		> 60 C	
ENGINE LUBE OIL TEMPERATURE	BIT	X		> 92 C	
HIGH INLET AIR MANIFOLD TEMPERATURE	BIT	X		> 92 C	
EXHAUST TO TURBO TEMP. (LEFT)	BIT	X		> 630 C	
EXHAUST TO TURBO TEMP. (RIGHT)	BIT	X		> 630 C	12 & 16 CYL ENGINE ONLY
EXHAUST FROM TURBO TEMP. (LEFT)	BIT	X		> 550 C	
EXHAUST FROM TURBO TEMP. (RIGHT)	BIT	X		> 550 C	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (1)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (2)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (3)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (4)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (5)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (6)	BIT	X		> 550 C	
CYLINDER TEMPERATURE (7)	BIT	X		> 550 C	8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (8)	BIT	X		> 550 C	8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (9)	BIT	X		> 550 C	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (10)	BIT	X		> 550 C	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (11)	BIT	X		> 550 C	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (12)	BIT	X		> 550 C	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (13)	BIT	X		> 550 C	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (14)	BIT	X		> 550 C	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (15)	BIT	X		> 550 C	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (16)	BIT	X		> 550 C	16 CYL ENGINE ONLY
SWITCHES/MISC. STATUS					
CYLINDER (1) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
CYLINDER (2) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	
CYLINDER (3) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	
CYLINDER (4) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	
CYLINDER (5) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	
CYLINDER (6) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	
CYLINDER (7) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	8, 12 & 16 CYL ENGINE ONLY
CYLINDER (8) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	8, 12 & 16 CYL ENGINE ONLY
CYLINDER (9) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	12 & 16 CYL ENGINE ONLY
CYLINDER (10) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	12 & 16 CYL ENGINE ONLY
CYLINDER (11) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	12 & 16 CYL ENGINE ONLY
CYLINDER (12) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	12 & 16 CYL ENGINE ONLY
CYLINDER (13) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	16 CYL ENGINE ONLY
CYLINDER (14) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	16 CYL ENGINE ONLY
CYLINDER (15) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	16 CYL ENGINE ONLY
CYLINDER (16) TEMPERATURE DEVIATION FROM AVG.	BIT	X		> 50 C	16 CYL ENGINE ONLY
LOW BATTERY VOLTAGE - SYSTEM	BIT	X		< 22 VDC	
LOW PLC MEMORY BATTERY VOLTAGE	BIT	X			RED BATT LIGHT ON PLC'S CPU
JACKET WATER DETECTION	BIT	X		CONTACT CLOSE	
EMERGENCY STOP	BIT		X	CONTACT CLOSE	
ENGINE SPEED SWITCH CRANK TERMINATE	BIT	X		> 170 RPM & 0 + 2SEC	

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
LOW ENGINE OIL SUMP LEVEL	BIT	X		MECHANICAL POSITION	
ENGINE PRE-LUBE (STARTING) PRESSURE AVAILABLE	BIT			> 9 kPa	ENGINE START INTERLOCK
OIL MIST DETECTION (SYSTEM READY STATUS)	BIT	X			
OIL MIST DETECTION (SHUTDOWN)	BIT		X	CONTACT CLOSE	
LOW EXPANSION TANK LEVEL SWITCH	BIT	X		CUSTOMER DEFINED	CUSTOMER SUPPLIED CONTACT
ENGINE OVERSPEED	BIT		X	113% RATED SPEED	PROVIDED BY SPEED SWITCH OR PLC
REDUCE ENGINE LOAD	BIT	X			MANUAL DECREASE LOAD
MAG PICK-UP (ENGINE SPEED SWITCH)	BIT	X		ST-008 AND NOT SE-004	SPEED SWITCH PICKUP
ENGINE CONTROL SWITCH - OFF	BIT			CONTACT CLOSE	
SENSOR FAILURES					
ENGINE LUBE OIL TEMPERATURE	BIT	X		< -50 OR > 150	
INLET AIR MANIFOLD TEMPERATURE	BIT	X		< -50 OR > 150	
ENGINE AC/OC CIRCUIT OUTLET WATER TEMP	BIT	X		< -50 OR > 150	
ENGINE JACKET WATER OUTLET TEMP (SHUTDOWN)	BIT	X		< -50 OR > 150	
ENGINE JACKET WATER OUTLET TEMP (ALARM)	BIT	X		< -50 OR > 150	
EXHAUST TO TURBO TEMP. (LEFT)	BIT	X		< -50 OR > 700	
EXHAUST TO TURBO TEMP. (RIGHT)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
EXHAUST FROM TURBO TEMP. (LEFT)	BIT	X		< -50 OR > 700	
EXHAUST FROM TURBO TEMP. (RIGHT)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (1)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (2)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (3)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (4)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (5)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (6)	BIT	X		< -50 OR > 700	
CYLINDER TEMPERATURE (7)	BIT	X		< -50 OR > 700	8, 12 & 16 CYL ENGINE ONLY

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
CYLINDER TEMPERATURE (8)	BIT	X		< -50 OR > 700	8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (9)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (10)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (11)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (12)	BIT	X		< -50 OR > 700	12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (13)	BIT	X		< -50 OR > 700	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (14)	BIT	X		< -50 OR > 700	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (15)	BIT	X		< -50 OR > 700	16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (16)	BIT	X		< -50 OR > 700	16 CYL ENGINE ONLY
ENGINE SPEED TRANSDUCER	BIT	X		< 3.85mA OR > 20.15mA	
LUBE OIL PRESSURE TO FILTER	BIT	X		< 3.85mA OR > 20.15mA	
LUBE OIL PRESSURE TO ENGINE	BIT	X		< 3.85mA OR > 20.15mA	
FUEL PRESSURE TO FILTER	BIT	X		< 3.85mA OR > 20.15mA	USED FOR DIFF ALARM
FUEL PRESSURE TO ENGINE	BIT	X		< 3.85mA OR > 20.15mA	
ENGINE JACKET WATER PRESSURE	BIT	X		< 3.85mA OR > 20.15mA	OPTIONAL
AC/OC CIRCUIT WATER PRESSURE	BIT	X		< 3.85mA OR > 20.15mA	OPTIONAL
SEA WATER PRESSURE	BIT	X		< 3.85mA OR > 20.15mA	OPTIONAL
ENGINE STARTING AIR PRESSURE	BIT	X		< 3.85mA OR > 20.15mA	OPTIONAL
ENGINE INLET AIR MANIFOLD PRESSURE	BIT	X		< 3.85mA OR > 20.15mA	
ENGINE LOW OIL PRESSURE CONTACTOR	BIT	X		NO SIGNAL - N.O. AND N.C.	LOW SPEED
ENGINE LOW OIL PRESSURE CONTACTOR	BIT	X		NO SIGNAL - N.O. AND N.C.	HIGH SPEED
ENGINE HIGH CRANKCASE PRESSURE CONTACTOR	BIT	X		NO SIGNAL - N.O. AND N.C.	
PRESSURE/ENGINE SPEED					
ENGINE SPEED TRANSDUCER	WORD		X	113% RATED SPEED	0-1200 RPM
LUBE OIL PRESSURE TO FILTER	WORD				0-1000 kPa USED FOR DIFF ALARM
LUBE OIL PRESSURE TO ENGINE	WORD	X		< 120 kPa & < 320 kPa	0-1000 kPa LOW SPEED & HIGH SPEED SETPOINTS
			X	< 105 kPa & < 260 kPa	

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
FUEL PRESSURE TO FILTER	WORD	X			0-1000 kPa USED FOR DIFF ALARM
FUEL PRESSURE TO ENGINE	WORD	X		< 260kPa	0-1000 kPa
ENGINE JACKET WATER PRESSURE	WORD	X		< 20 kPa (LOW RPM)	0-1000 kPa
				< 35 kPa (HI RPM)	OPTIONAL
AC/OC CIRCUIT WATER PRESSURE	WORD	X		< 35 kPa	0-1000 kPa OPTIONAL
SEA WATER PRESSURE	WORD	X		< 35 kPa	0-1000 kPa OPTIONAL
ENGINE STARTING AIR PRESSURE	WORD	X		< 750 kPa	0-4000 kPa OPTIONAL
ENGINE INLET AIR MANIFOLD PRESSURE	WORD	X		> 230 kPa	0-1000 kPa
RTD AND THERMOCOUPLE					
ENGINE LUBE OIL TEMPERATURE	WORD	X		> 92 C	0-150 C
INLET AIR MANIFOLD TEMPERATURE	WORD	X		> 92 C	0-150 C
ENGINE AC/OC CIRCUIT OUTLET WATER TEMP	WORD	X		> 65 C	0-150 C
ENGINE JACKET WATER OUTLET TEMP (SHUTDOWN)	WORD		X	> 109 C	0-150 C
ENGINE JACKET WATER OUTLET TEMP (ALARM)	WORD	X		> 103 C	0-150 C
EXHAUST TO TURBO TEMP. (LEFT)	WORD	X		> 630 C	0-700 C
EXHAUST TO TURBO TEMP. (RIGHT)	WORD	X		> 630 C	0-700 C 12 & 16 CYL ENGINE ONLY
EXHAUST FROM TURBO TEMP. (LEFT)	WORD	X		> 550 C	0-700 C
EXHAUST FROM TURBO TEMP. (RIGHT)	WORD	X		> 550 C	0-700 C 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (1)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (2)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (3)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (4)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (5)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (6)	WORD	X		> 550 C	0-700 C
CYLINDER TEMPERATURE (7)	WORD	X		> 550 C	0-700 C 8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (8)	WORD	X		> 550 C	0-700 C 8, 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (9)	WORD	X		> 550 C	0-700 C 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (10)	WORD	X		> 550 C	0-700 C 12 & 16 CYL ENGINE ONLY

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
CYLINDER TEMPERATURE (11)	WORD	X		> 550 C	0-700 C 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (12)	WORD	X		> 550 C	0-700 C 12 & 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (13)	WORD	X		> 550 C	0-700 C 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (14)	WORD	X		> 550 C	0-700 C 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (15)	WORD	X		> 550 C	0-700 C 16 CYL ENGINE ONLY
CYLINDER TEMPERATURE (16)	WORD	X		> 550 C	0-700 C 16 CYL ENGINE ONLY
AVG. OF EXHAUST PORT TEMP. FOR DEVIATION CALC	WORD				0-700 C
CONTROL SENSORS					
MAG PICK-UP (ENGINE SPEED)	4-20mA		X	113% RATED SPEED	0-1200 RPM
LUBE OIL PRESSURE TO ENGINE	4-20mA	X	X	< 320kPa	0-1000 kPa
				< 120kPa	
ENGINE HIGH EXHAUST TEMPERATURE FROM TURBO RIGHT SIDE	4-20mA	X		> 630 C	0-700 C
ENGINE HIGH EXHAUST TEMPERATURE FROM TURBO LEFT SIDE	4-20mA	X		> 630 C	0-700 C
AUX SWITCH OUT 1	24VDC				CONTROLLED AT MONITOR
HIGH CRANKCASE PRESSURE SHUTDOWN	NC		X	PSHH-003	RCPHS RELAY
LOW ENGINE OIL PRESSURE SHUTDOWN	NC		X	PSLL-001 OR PT-002	ROPLS RELAY
ENGINE OVERSPEED SHUTDOWN	NC		X	SS-002	ROSR RELAY
FUEL CONTROL RELAY	NO,NC		X	SWITCH OR FAULT	RFCR RELAY
LOW MARINE GEAR PRESSURE SHUTDOWN	NC		X	PSLL-020	RGOPLS RELAY
ALARM HORN AND BEACON	NO	X	X	ALARM OR SHUTDOWN	RHB RELAY
SUMMARY SHUTDOWN (ENGINE FAULT)	NC		X	RELAY SHUTDOWN	REFR RELAY
ENGINE RUNNING (CRANK TERMINATE)	NO			ENGINE SPEED > 170 RPM	RCTR RELAY
PRELUBE ENGINE	NO			PS-008 > 9 kPa	RPR RELAY
CIRCUIT BREAKER TRIP ALARM	NC	X		CIRCUIT BREAKER OPENS	AUX CONTACTS ON CIRCUIT BREAKERS
REDUCE ENGINE LOAD	NO,NC				REL RELAY
ENGINE ALARM SUMMARY	NO	X			

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Sensor Description	Signal Type	Alarm	Shut Down	Setpoint Trip	Comments
LUBE OIL STANDBY PUMP	24VDC			< 115 kPa	CUSTOMER SUPPLIED INTERFACE 24VDC PROVIDED TO CUSTOMER INTERFACE
AIR START SIGNAL TO ENGINE	DIGITAL				REMOTE SSTART ONLY - RAS RELAY
FUEL SHUTOFF SIGNAL TO ENGINE	DIGITAL		X	SHUTDOWN OR FUEL OFF	RFCR RELAY
AIR SHUTOFF SIGNAL TO ENGINE	DIGITAL			OVERSPEED & E-STOP	ASOS SOLENOID
ENGINE PRELUBE SIGNAL TO ENGINE	DIGITAL			> 9 kPa	RPR RELAY
ENGINE PROTECTION SYSTEM OVERRIDE RELAY ON	DIGITAL				ROVR RELAY - OVERRIDE SHUTDOWNS
SUMMARY GROUP ALARM RELAY ACTIVATE	DIGITAL	X		ANY ALARM	RSA RELAY
SUMMARY GROUP SHUTDOWN SIGNAL	DIGITAL		X	PROTECTIVE SHUTDOWN	ENERGIZES REFR RELAY ON PROT SHUTDOWN
JACKET WATER DETECTION RELAY	DIGITAL	X			RJWDA RELAY
ENGINE SPEED TACHOMETER	FREQ				MAG PICKUP DRIVEN
ENGINE HOUR METER	DIGITAL				
STARTING AIR PRESSURE METER	OHMS				RESISTIVE SENSOR
SUMMARY ALARM LIGHT	DIGITAL	X		ANY ALARM	
SUMMARY SHUTDOWN LIGHT	DIGITAL		X	PROTECTIVE SHUTDOWN	
PLC FAILURE	DIGITAL	X		NO SIGNAL TO RPLCFA	RPLCFA DE-ENERGIZED ON PLC FAILURE
ENGINE PRELUBED	DIGITAL			> 9 kPa	

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MODBUS Address List

ANALOG DATA	MODBUS ADDRESS
FUEL RACK POSITION	40001
LUBE OIL TO ENGINE TEMPERATURE (C)	40002
LUBE OIL TO ENGINE PRESSURE (kPa)	40003
LUBE OIL TO FILTER PRESSURE (kPa)	40004
INLET AIR MANIFOLD TEMPERATURE (C)	40005
INLET AIR MANIFOLD PRESSURE (kPa)	40006
FUEL TO ENGINE TEMPERATURE (C)	40007
FUEL TO ENGINE PRESSURE (kPa)	40008
FUEL TO FILTER PRESSURE (kPa)	40009
JACKET WATER OUTLET TEMPERATURE (C)	40010
REDUNDANT JACKET WATER OUTLET TEMPERATURE (C)	40011
JACKET WATER PRESSURE (kPa)	40012
AC/OC WATER INLET TEMPERATURE (C)	40013
AC/OC PUMP PRESSURE (kPa)	40014
RAW WATER PRESSURE (kPa)	40015
AUXILIARY #1 TEMPERATURE (C)	40016
AUXILIARY #2 TEMPERATURE (C)	40017
AUXILIARY #1 4-20mA (kPa)	40018
AUXILIARY #2 4-20mA (kPa)	40019
AIR START PRESSURE (kPa)	40020
NON-DRIVE BEARING TEMPERATURE (C)	40021
DRIVE BEARING TEMPERATURE (C)	40022
STATOR A TEMPERATURE (C)	40023
STATOR B TEMPERATURE (C)	40024
STATOR C TEMPERATURE (C)	40025
TURBINE INLET LEFT/INLINE TEMPERATURE (C)	40026
TURBINE INLET RIGHT TEMPERATURE (C)	40027
TURBINE OUTLET LEFT/INLINE TEMPERATURE (C)	40028
TURBINE OUTLET RIGHT TEMPERATURE (C)	40029
EXHAUST PORT #1 TEMPERATURE (C)	40030
EXHAUST PORT #2 TEMPERATURE (C)	40031
EXHAUST PORT #3 TEMPERATURE (C)	40032
EXHAUST PORT #4 TEMPERATURE (C)	40033
EXHAUST PORT #5 TEMPERATURE (C)	40034
EXHAUST PORT #6 TEMPERATURE (C)	40035
EXHAUST PORT #7 TEMPERATURE (C)	40036
EXHAUST PORT #8 TEMPERATURE (C)	40037
EXHAUST PORT #9 TEMPERATURE (C)	40038
EXHAUST PORT #10 TEMPERATURE (C)	40039
EXHAUST PORT #11 TEMPERATURE (C)	40040
EXHAUST PORT #12 TEMPERATURE (C)	40041
EXHAUST PORT #13 TEMPERATURE (C)	40042
EXHAUST PORT #14 TEMPERATURE (C)	40043
EXHAUST PORT #15 TEMPERATURE (C)	40044
EXHAUST PORT #16 TEMPERATURE (C)	40045
WRITE SPARE	40046
WRITE SPARE	40047
WRITE SPARE	40048
WRITE SPARE	40049
TURBINE LEFT/INLINE SPEED (RPM)	40050
TURBINE RIGHT SPEED (RPM)	40051
ENGINE SPEED (RPM)	40052

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ANALOG DATA	MODBUS ADDRESS
EXHAUST PORT #1 TEMPERATURE DEVIATION (C)	40053
EXHAUST PORT #2 TEMPERATURE DEVIATION (C)	40054
EXHAUST PORT #3 TEMPERATURE DEVIATION (C)	40055
EXHAUST PORT #4 TEMPERATURE DEVIATION (C)	40056
EXHAUST PORT #5 TEMPERATURE DEVIATION (C)	40057
EXHAUST PORT #6 TEMPERATURE DEVIATION (C)	40058
EXHAUST PORT #7 TEMPERATURE DEVIATION (C)	40059
EXHAUST PORT #8 TEMPERATURE DEVIATION (C)	40060
EXHAUST PORT #9 TEMPERATURE DEVIATION (C)	40061
EXHAUST PORT #10 TEMPERATURE DEVIATION (C)	40062
EXHAUST PORT #11 TEMPERATURE DEVIATION (C)	40063
EXHAUST PORT #12 TEMPERATURE DEVIATION (C)	40064
EXHAUST PORT #13 TEMPERATURE DEVIATION (C)	40065
EXHAUST PORT #14 TEMPERATURE DEVIATION (C)	40066
EXHAUST PORT #15 TEMPERATURE DEVIATION (C)	40067
EXHAUST PORT #16 TEMPERATURE DEVIATION (C)	40068
WRITE SPARE	40069
WRITE SPARE	40070
WRITE SPARE	40071
WRITE SPARE	40072
FUEL FILTER PRESSURE DIFFERENTIAL (kPa)	40073
LUBE OIL FILTER PRESSURE DIFFERENTIAL (kPa)	40074
WRITE SPARE	40075
WRITE SPARE	40076
WRITE SPARE	40077
WRITE SPARE	40078
WRITE SPARE	40079
WRITE SPARE	40080
WRITE SPARE	40081
WRITE SPARE	40082
WRITE SPARE	40083
WRITE SPARE	40084
WRITE SPARE	40085
WRITE SPARE	40086
WRITE SPARE	40087
WRITE SPARE	40088
WRITE SPARE	40089
WRITE SPARE	40090
WRITE SPARE	40091
WRITE SPARE	40092
WRITE SPARE	40093
WRITE SPARE	40094
WRITE SPARE	40095
WRITE SPARE	40096
WRITE SPARE	40097
WRITE SPARE	40098
WRITE SPARE	40099
WRITE SPARE	40100

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ANALOG DATA	MODBUS ADDRESS
LUBE OIL TO ENGINE TEMPERATURE (F)	40101
LUBE OIL TO ENGINE PRESSURE (psi)	40102
LUBE OIL TO FILTER PRESSURE (psi)	40103
INLET AIR MANIFOLD TEMPERATURE (F)	40104
INLET AIR MANIFOLD PRESSURE (psi)	40105
FUEL TO ENGINE TEMPERATURE (F)	40106
FUEL TO ENGINE PRESSURE (psi)	40107
FUEL TO FILTER PRESSURE (psi)	40108
JACKET WATER OUTLET TEMPERATURE (F)	40109
REDUNDANT JACKET WATER OUTLET TEMPERATURE (F)	40110
JACKET WATER PRESSURE (psi)	40111
AC/OC WATER INLET TEMPERATURE (F)	40112
AC/OC PUMP PRESSURE (psi)	40113
RAW WATER PRESSURE (psi)	40114
AUXILIARY #1 TEMPERATURE (F)	40115
AUXILIARY #2 TEMPERATURE (F)	40116
AUXILIARY #1 4-20mA (psi)	40117
AUXILIARY #2 4-20mA (psi)	40118
AIR START PRESSURE (psi)	40119
NON-DRIVE BEARING TEMPERATURE (F)	40120
DRIVE BEARING TEMPERATURE (F)	40121
STATOR A TEMPERATURE (F)	40122
STATOR B TEMPERATURE (F)	40123
STATOR C TEMPERATURE (F)	40124
TURBINE INLET LEFT/INLINE TEMPERATURE (F)	40125
TURBINE INLET RIGHT TEMPERATURE (F)	40126
TURBINE OUTLET LEFT/INLINE TEMPERATURE (F)	40127
TURBINE OUTLET RIGHT TEMPERATURE (F)	40128
EXHAUST PORT #1 TEMPERATURE (F)	40129
EXHAUST PORT #2 TEMPERATURE (F)	40130
EXHAUST PORT #3 TEMPERATURE (F)	40131
EXHAUST PORT #4 TEMPERATURE (F)	40132
EXHAUST PORT #5 TEMPERATURE (F)	40133
EXHAUST PORT #6 TEMPERATURE (F)	40134
EXHAUST PORT #7 TEMPERATURE (F)	40135
EXHAUST PORT #8 TEMPERATURE (F)	40136
EXHAUST PORT #9 TEMPERATURE (F)	40137
EXHAUST PORT #10 TEMPERATURE (F)	40138
EXHAUST PORT #11 TEMPERATURE (F)	40139
EXHAUST PORT #12 TEMPERATURE (F)	40140
EXHAUST PORT #13 TEMPERATURE (F)	40141
EXHAUST PORT #14 TEMPERATURE (F)	40142
EXHAUST PORT #15 TEMPERATURE (F)	40143
EXHAUST PORT #16 TEMPERATURE (F)	40144
WRITE SPARE	40145
WRITE SPARE	40146
WRITE SPARE	40147
WRITE SPARE	40148

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ANALOG DATA	MODBUS ADDRESS
EXHAUST PORT #1 TEMPERATURE DEVIATION (F)	40149
EXHAUST PORT #2 TEMPERATURE DEVIATION (F)	40150
EXHAUST PORT #3 TEMPERATURE DEVIATION (F)	40151
EXHAUST PORT #4 TEMPERATURE DEVIATION (F)	40152
EXHAUST PORT #5 TEMPERATURE DEVIATION (F)	40153
EXHAUST PORT #6 TEMPERATURE DEVIATION (F)	40154
EXHAUST PORT #7 TEMPERATURE DEVIATION (F)	40155
EXHAUST PORT #8 TEMPERATURE DEVIATION (F)	40156
EXHAUST PORT #9 TEMPERATURE DEVIATION (F)	40157
EXHAUST PORT #10 TEMPERATURE DEVIATION (F)	40158
EXHAUST PORT #11 TEMPERATURE DEVIATION (F)	40159
EXHAUST PORT #12 TEMPERATURE DEVIATION (F)	40160
EXHAUST PORT #13 TEMPERATURE DEVIATION (F)	40161
EXHAUST PORT #14 TEMPERATURE DEVIATION (F)	40162
EXHAUST PORT #15 TEMPERATURE DEVIATION (F)	40163
EXHAUST PORT #16 TEMPERATURE DEVIATION (F)	40164
WRITE SPARE	40165
WRITE SPARE	40166
WRITE SPARE	40167
WRITE SPARE	40168
FUEL FILTER PRESSURE DIFFERENTIAL (psi)	40169
LUBE OIL FILTER PRESSURE DIFFERENTIAL (psi)	40170
WRITE SPARE	40171
WRITE SPARE	40172
WRITE SPARE	40173
WRITE SPARE	40174
WRITE SPARE	40175
WRITE SPARE	40176
WRITE SPARE	40177
WRITE SPARE	40178
WRITE SPARE	40179
WRITE SPARE	40180
WRITE SPARE	40181
WRITE SPARE	40182
WRITE SPARE	40183
WRITE SPARE	40184
WRITE SPARE	40185
WRITE SPARE	40186
WRITE SPARE	40187
WRITE SPARE	40188
WRITE SPARE	40189
WRITE SPARE	40190
WRITE SPARE	40191
WRITE SPARE	40192
WRITE SPARE	40193
WRITE SPARE	40194
WRITE SPARE	40195
WRITE SPARE	40196
WRITE SPARE	40197
WRITE SPARE	40198
WRITE SPARE	40199
WRITE SPARE	40200

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ANALOG DATA	MODBUS ADDRESS
PM3000 VOLTAGE	40201
PM3000 VOLTAGE	40202
PM3000 VOLTAGE	40203
PM3000 VOLTAGE	40204
PM3000 VOLTAGE	40205
PM3000 VOLTAGE	40206
PM3000 VOLTAGE	40207
PM3000 VOLTAGE	40208
PM3000 VOLTAGE	40209
PM3000 VOLTAGE	40210
PM3000 VOLTAGE	40211
PM3000 VOLTAGE	40212
PM3000 CURRENT	40213
PM3000 CURRENT	40214
PM3000 CURRENT	40215
PM3000 POWER	40216
PM3000 POWER	40217
PM3000 POWER	40218
PM3000 POWER	40219
PM3000 POWER	40220
PM3000 POWER	40221
PM3000 POWER FACTOR	40222
PM3000 POWER FACTOR	40223
PM3000 FREQUENCY	40224
PM3000 FREQUENCY	40225
WRITE SPARE	40226
WRITE SPARE	40227
WRITE SPARE	40228
WRITE SPARE	40229
WRITE SPARE	40230
WRITE SPARE	40231
WRITE SPARE	40232
WRITE SPARE	40233
WRITE SPARE	40234
WRITE SPARE	40235
WRITE SPARE	40236
WRITE SPARE	40237
WRITE SPARE	40238
WRITE SPARE	40239
WRITE SPARE	40240
WRITE SPARE	40241
WRITE SPARE	40242
WRITE SPARE	40243
WRITE SPARE	40244
WRITE SPARE	40245
WRITE SPARE	40246
WRITE SPARE	40247
WRITE SPARE	40248
WRITE SPARE	40249
WRITE SPARE	40250

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40251
LUBE OIL TO ENGINE TEMPERATURE SENSOR FAILURE ALARM	40251.01
LUBE OIL TO ENGINE TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.02
LUBE OIL TO ENGINE PRESSURE SENSOR FAILURE ALARM	40251.03
LUBE OIL TO ENGINE PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.04
LUBE OIL TO FILTER PRESSURE SENSOR FAILURE ALARM	40251.05
LUBE OIL TO FILTER PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.06
INLET AIR MANIFOLD TEMPERATURE SENSOR FAILURE ALARM	40251.07
INLET AIR MANIFOLD TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.08
INLET AIR MANIFOLD PRESSURE SENSOR FAILURE ALARM	40251.09
INLET AIR MANIFOLD PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.10
FUEL TO ENGINE TEMPERATURE SENSOR FAILURE ALARM	40251.11
FUEL TO ENGINE TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.12
FUEL TO ENGINE PRESSURE SENSOR FAILURE ALARM	40251.13
FUEL TO ENGINE PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.14
FUEL TO FILTER PRESSURE SENSOR FAILURE ALARM	40251.15
FUEL TO FILTER PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40251.16
ALARM STATUS	40252
JACKET WATER OUTLET TEMPERATURE SENSOR FAILURE ALARM	40252.01
JACKET WATER OUTLET TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.02
REDUNDANT JACKET WATER OUTLET TEMPERATURE SENSOR FAILURE ALARM	40252.03
REDUNDANT JACKET WATER OUTLET TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.04
JACKET WATER PRESSURE SENSOR FAILURE ALARM	40252.05
JACKET WATER PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.06
AC/OC WATER INLET TEMPERATURE SENSOR FAILURE ALARM	40252.07
AC/OC WATER INLET TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.08
AC/OC PUMP PRESSURE SENSOR FAILURE ALARM	40252.09
AC/OC PUMP PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.10
RAW WATER PRESSURE SENSOR FAILURE ALARM	40252.11
RAW WATER PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.12
AUXILIARY #1 TEMPERATURE SENSOR FAILURE ALARM	40252.13
AUXILIARY #1 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.14
AUXILIARY #2 TEMPERATURE SENSOR FAILURE ALARM	40252.15
AUXILIARY #2 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40252.16
ALARM STATUS	40253
AUXILIARY #1 4-20mA SENSOR FAILURE ALARM	40253.01
AUXILIARY #1 4-20mA SENSOR FAILURE ALARM ACKNOWLEDGED	40253.02
AUXILIARY #2 4-20mA SENSOR FAILURE ALARM	40253.03
AUXILIARY #2 4-20mA SENSOR FAILURE ALARM ACKNOWLEDGED	40253.04
AIR START PRESSURE SENSOR FAILURE ALARM	40253.05
AIR START PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.06
NON-DRIVE BEARING TEMPERATURE SENSOR FAILURE ALARM	40253.07
NON-DRIVE BEARING TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.08
DRIVE BEARING TEMPERATURE SENSOR FAILURE ALARM	40253.09
DRIVE BEARING TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.10
STATOR A TEMPERATURE SENSOR FAILURE ALARM	40253.11
STATOR A TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.12
STATOR B TEMPERATURE SENSOR FAILURE ALARM	40253.13
STATOR B TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.14
STATOR C TEMPERATURE SENSOR FAILURE ALARM	40253.15
STATOR C TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40253.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40254
TURBINE INLET LEFT/INLINE TEMPERATURE SENSOR FAILURE ALARM	40254.01
TURBINE INLET LEFT/INLINE TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.02
TURBINE INLET RIGHT TEMPERATURE SENSOR FAILURE ALARM	40254.03
TURBINE INLET RIGHT TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.04
TURBINE OUTLET LEFT/INLINE TEMPERATURE SENSOR FAILURE ALARM	40254.05
TURBINE OUTLET LEFT/INLINE TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.06
TURBINE OUTLET RIGHT TEMPERATURE SENSOR FAILURE ALARM	40254.07
TURBINE OUTLET RIGHT TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.08
EXHAUST PORT #1 TEMPERATURE SENSOR FAILURE ALARM	40254.09
EXHAUST PORT #1 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.10
EXHAUST PORT #2 TEMPERATURE SENSOR FAILURE ALARM	40254.11
EXHAUST PORT #2 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.12
EXHAUST PORT #3 TEMPERATURE SENSOR FAILURE ALARM	40254.13
EXHAUST PORT #3 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.14
EXHAUST PORT #4 TEMPERATURE SENSOR FAILURE ALARM	40254.15
EXHAUST PORT #4 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40254.16
ALARM STATUS	40255
EXHAUST PORT #5 TEMPERATURE SENSOR FAILURE ALARM	40255.01
EXHAUST PORT #5 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.02
EXHAUST PORT #6 TEMPERATURE SENSOR FAILURE ALARM	40255.03
EXHAUST PORT #6 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.04
EXHAUST PORT #7 TEMPERATURE SENSOR FAILURE ALARM	40255.05
EXHAUST PORT #7 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.06
EXHAUST PORT #8 TEMPERATURE SENSOR FAILURE ALARM	40255.07
EXHAUST PORT #8 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.08
EXHAUST PORT #9 TEMPERATURE SENSOR FAILURE ALARM	40255.09
EXHAUST PORT #9 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.10
EXHAUST PORT #10 TEMPERATURE SENSOR FAILURE ALARM	40255.11
EXHAUST PORT #10 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.12
EXHAUST PORT #11 TEMPERATURE SENSOR FAILURE ALARM	40255.13
EXHAUST PORT #11 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40255.14
EXHAUST PORT #12 TEMPERATURE SENSOR FAILURE ALARM	40255.15
EXHAUST PORT #12 TEMPERATURE SENSOR FAILURE ALARM ACKNOWELDGED	40255.16
ALARM STATUS	40256
EXHAUST PORT #13 TEMPERATURE SENSOR FAILURE ALARM	40256.01
EXHAUST PORT #13 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40256.02
EXHAUST PORT #14 TEMPERATURE SENSOR FAILURE ALARM	40256.03
EXHAUST PORT #14 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40256.04
EXHAUST PORT #15 TEMPERATURE SENSOR FAILURE ALARM	40256.05
EXHAUST PORT #15 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40256.06
EXHAUST PORT #16 TEMPERATURE SENSOR FAILURE ALARM	40256.07
EXHAUST PORT #16 TEMPERATURE SENSOR FAILURE ALARM ACKNOWLEDGED	40256.08
TURBINE LEFT/INLINE SPEED SENSOR FAILURE ALARM	40256.09
TURBINE LEFT/INLINE SPEED SENSOR FAILURE ALARM ACKNOWLEDGED	40256.10
TURBINE RIGHT SPEED SENSOR FAILURE ALARM	40256.11
TURBINE RIGHT SPEED SENSOR FAILURE ALARM ACKNOWLEDGED	40256.12
ENGINE SPEED SENSOR FAILURE ALARM	40256.13
ENGINE SPEED SENSOR FAILURE ALARM ACKNOWLEDGED	40256.14
BALL HEAD BACKUP MODE SENSOR FAILURE ALARM	40256.15
BALL HEAD BACKUP MODE SENSOR FAILURE ALARM ACKNOWLEDGED	40256.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40257
CRANKCASE PRESSURE SENSOR FAILURE ALARM	40257.01
CRANKCASE PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40257.02
OIL MIST DETECTOR SENSOR FAILURE ALARM	40257.03
OIL MIST DETECTOR SENSOR FAILURE ALARM ACKNOWLEDGED	40257.04
LOW SPEED LOW OIL PRESSURE SENSOR FAILURE ALARM	40257.05
LOW SPEED LOW OIL PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40257.06
HIGH SPEED LOW OIL PRESSURE SENSOR FAILURE ALARM	40257.07
HIGH SPEED LOW OIL PRESSURE SENSOR FAILURE ALARM ACKNOWLEDGED	40257.08
LUBE OIL TO ENGINE TEMPERATURE HIGH ALARM	40257.09
LUBE OIL TO ENGINE TEMPERATURE HIGH ALARM ACKNOWLEDGED	40257.10
LUBE OIL TO ENGINE PRESSURE LOW ALARM	40257.11
LUBE OIL TO ENGINE PRESSURE LOW ALARM ACKNOWLEDGED	40257.12
LUBE OIL TO FILTER PRESSURE HIGH ALARM	40257.13
LUBE OIL TO FILTER PRESSURE HIGH ALARM ACKNOWLEDGED	40257.14
INLET AIR MANIFOLD TEMPERATURE HIGH ALARM	40257.15
INLET AIR MANIFOLD TEMPERATURE HIGH ALARM ACKNOWLEDGED	40257.16
ALARM STATUS	40258
INLET AIR MANIFOLD PRESSURE HIGH ALARM	40258.01
INLET AIR MANIFOLD PRESSURE HIGH ALARM ACKNOWLEDGED	40258.02
FUEL TO ENGINE TEMPERATURE HIGH ALARM	40258.03
FUEL TO ENGINE TEMPERATURE HIGH ALARM ACKNOWLEDGED	40258.04
FUEL TO ENGINE PRESSURE LOW ALARM	40258.05
FUEL TO ENGINE PRESSURE LOW ALARM ACKNOWLEDGED	40258.06
JACKET WATER OUTLET TEMPERATURE HIGH ALARM	40258.07
JACKET WATER OUTLET TEMPERATURE HIGH ALARM ACKNOWLEDGED	40258.08
JACKET WATER PRESSURE LOW ALARM	40258.09
JACKET WATER PRESSURE LOW ALARM ACKNOWLEDGED	40258.10
AC/OC WATER INLET TEMPERATURE HIGH ALARM	40258.11
AC/OC WATER INLET TEMPERATURE HIGH ALARM ACKNOWLEDGED	40258.12
AC/OC PUMP PRESSURE LOW ALARM	40258.13
AC/OC PUMP PRESSURE LOW ALARM ACKNOWLEDGED	40258.14
RAW WATER PRESSURE LOW ALARM	40258.15
RAW WATER PRESSURE LOW ALARM ACKNOWLEDGED	40258.16
ALARM STATUS	40259
AUXILIARY #1 TEMPERATURE ALARM	40259.01
AUXILIARY #1 TEMPERATURE ALARM ACKNOWLEDGED	40259.02
AUXILIARY #2 TEMPERATURE ALARM	40259.03
AUXILIARY #2 TEMPERATURE ALARM ACKNOWLEDGED	40259.04
AUXILIARY #1 4-20mA ALARM	40259.05
AUXILIARY #1 4-20mA ALARM ACKNOWLEDGED	40259.06
AUXILIARY #2 4-20mA ALARM	40259.07
AUXILIARY #2 4-20mA ALARM ACKNOWLEDGED	40259.08
AIR START PRESSURE LOW ALARM	40259.09
AIR START PRESSURE LOW ALARM ACKNOWLEDGED	40259.10
NON-DRIVE BEARING TEMPERATURE HIGH ALARM	40259.11
NON-DRIVE BEARING TEMPERATURE HIGH ALARM ACKNOWLEDGED	40259.12
DRIVE BEARING TEMPERATURE HIGH ALARM	40259.13
DRIVE BEARING TEMPERATURE HIGH ALARM ACKNOWLEDGED	40259.14
STATOR A TEMPERATURE HIGH ALARM	40259.15
STATOR A TEMPERATURE HIGH ALARM ACKNOWLEDGED	40259.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40260
STATOR B TEMPERATURE HIGH ALARM	40260.01
STATOR B TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.02
STATOR C TEMPERATURE HIGH ALARM	40260.03
STATOR C TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.04
TURBINE INLET LEFT/INLINE TEMPERATURE HIGH ALARM	40260.05
TURBINE INLET LEFT/INLINE TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.06
TURBINE INLET RIGHT TEMPERATURE HIGH ALARM	40260.07
TURBINE INLET RIGHT TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.08
TURBINE OUTLET LEFT/INLINE TEMPERATURE HIGH ALARM	40260.09
TURBINE OUTLET LEFT/INLINE TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.10
TURBINE OUTLET RIGHT TEMPERATURE HIGH ALARM	40260.11
TURBINE OUTLET RIGHT TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.12
EXHAUST PORT #1 TEMPERATURE HIGH ALARM	40260.13
EXHAUST PORT #1 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.14
EXHAUST PORT #2 TEMPERATURE HIGH ALARM	40260.15
EXHAUST PORT #2 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40260.16
ALARM STATUS	40261
EXHAUST PORT #3 TEMPERATURE HIGH ALARM	40261.01
EXHAUST PORT #3 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.02
EXHAUST PORT #4 TEMPERATURE HIGH ALARM	40261.03
EXHAUST PORT #4 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.04
EXHAUST PORT #5 TEMPERATURE HIGH ALARM	40261.05
EXHAUST PORT #5 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.06
EXHAUST PORT #6 TEMPERATURE HIGH ALARM	40261.07
EXHAUST PORT #6 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.08
EXHAUST PORT #7 TEMPERATURE HIGH ALARM	40261.09
EXHAUST PORT #7 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.10
EXHAUST PORT #8 TEMPERATURE HIGH ALARM	40261.11
EXHAUST PORT #8 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.12
EXHAUST PORT #9 TEMPERATURE HIGH ALARM	40261.13
EXHAUST PORT #9 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.14
EXHAUST PORT #10 TEMPERATURE HIGH ALARM	40261.15
EXHAUST PORT #10 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40261.16
ALARM STATUS	40262
EXHAUST PORT #11 TEMPERATURE HIGH ALARM	40262.01
EXHAUST PORT #11 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40262.02
EXHAUST PORT #12 TEMPERATURE HIGH ALARM	40262.03
EXHAUST PORT #12 TEMPERATURE HIGH ALARM ACKNOWELDGED	40262.04
EXHAUST PORT #13 TEMPERATURE HIGH ALARM	40262.05
EXHAUST PORT #13 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40262.06
EXHAUST PORT #14 TEMPERATURE HIGH ALARM	40262.07
EXHAUST PORT #14 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40262.08
EXHAUST PORT #15 TEMPERATURE HIGH ALARM	40262.09
EXHAUST PORT #15 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40262.10
EXHAUST PORT #16 TEMPERATURE HIGH ALARM	40262.11
EXHAUST PORT #16 TEMPERATURE HIGH ALARM ACKNOWLEDGED	40262.12
TURBINE LEFT/INLINE OVERSPEED ALARM	40262.13
TURBINE LEFT/INLINE OVERSPEED ALARM ACKNOWLEDGED	40262.14
TURBINE RIGHT OVERSPEED ALARM	40262.15
TURBINE RIGHT OVERSPEED ALARM ACKNOWLEDGED	40262.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40263
BALL HEAD BACKUP MODE ALARM	40263.01
BALL HEAD BACKUP MODE ALARM ACKNOWLEDGED	40263.02
ENGINE CRANK TERMINATE ALARM	40263.03
ENGINE CRANK TERMINATE ALARM ACKNOWLEDGED	40263.04
ENGINE CRANK TERMINATE TIME DELAY ALARM	40263.05
ENGINE CRANK TERMINATE TIME DELAY ALARM ACKNOWLEDGED	40263.06
ENGINE OIL STEP ALARM	40263.07
ENGINE OIL STEP ALARM ACKNOWLEDGED	40263.08
OIL LEVEL LOW ALARM	40263.09
OIL LEVEL LOW ALARM ACKNOWLEDGED	40263.10
PARTICLE DETECTOR ALARM	40263.11
PARTICLE DETECTOR ALARM ACKNOWLEDGED	40263.12
WATER LEVEL LOW ALARM	40263.13
WATER LEVEL LOW ALARM ACKNOWLEDGED	40263.14
JACKET WATER DETECTOR ALARM	40263.15
JACKET WATER DETECTOR ALARM ACKNOWLEDGED	40263.16
ALARM STATUS	40264
LOW BATTERY VOLTAGE ALARM	40264.01
LOW BATTERY VOLTAGE ALARM ACKNOWLEDGED	40264.02
RELAY POWER NOT AVAILABLE ALARM	40264.03
RELAY POWER NOT AVAILABLE ALARM ACKNOWLEDGED	40264.04
AUXILIARY #1 ALARM	40264.05
AUXILIARY #1 ALARM ACKNOWLEDGED	40264.06
AUXILIARY #2 ALARM	40264.07
AUXILIARY #2 ALARM ACKNOWLEDGED	40264.08
AUXILIARY #3 ALARM	40264.09
AUXILIARY #3 ALARM ACKNOWLEDGED	40264.10
SHUTDOWN OVERRIDE ALARM	40264.11
SHUTDOWN OVERRIDE ALARM ACKNOWLEDGED	40264.12
EXHAUST PORT #1 TEMPERATURE DEVIATION ALARM	40264.13
EXHAUST PORT #1 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40264.14
EXHAUST PORT #2 TEMPERATURE DEVIATION ALARM	40264.15
EXHAUST PORT #2 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40264.16
ALARM STATUS	40265
EXHAUST PORT #3 TEMPERATURE DEVIATION ALARM	40265.01
EXHAUST PORT #3 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.02
EXHAUST PORT #4 TEMPERATURE DEVIATION ALARM	40265.03
EXHAUST PORT #4 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.04
EXHAUST PORT #5 TEMPERATURE DEVIATION ALARM	40265.05
EXHAUST PORT #5 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.06
EXHAUST PORT #6 TEMPERATURE DEVIATION ALARM	40265.07
EXHAUST PORT #6 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.08
EXHAUST PORT #7 TEMPERATURE DEVIATION ALARM	40265.09
EXHAUST PORT #7 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.10
EXHAUST PORT #8 TEMPERATURE DEVIATION ALARM	40265.11
EXHAUST PORT #8 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.12
EXHAUST PORT #9 TEMPERATURE DEVIATION ALARM	40265.13
EXHAUST PORT #9 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.14
EXHAUST PORT #10 TEMPERATURE DEVIATION ALARM	40265.15
EXHAUST PORT #10 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40265.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40266
EXHAUST PORT #11 TEMPERATURE DEVIATION ALARM	40266.01
EXHAUST PORT #11 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.02
EXHAUST PORT #12 TEMPERATURE DEVIATION ALARM	40266.03
EXHAUST PORT #12 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.04
EXHAUST PORT #13 TEMPERATURE DEVIATION ALARM	40266.05
EXHAUST PORT #13 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.06
EXHAUST PORT #14 TEMPERATURE DEVIATION ALARM	40266.07
EXHAUST PORT #14 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.08
EXHAUST PORT #15 TEMPERATURE DEVIATION ALARM	40266.09
EXHAUST PORT #15 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.10
EXHAUST PORT #16 TEMPERATURE DEVIATION ALARM	40266.11
EXHAUST PORT #16 TEMPERATURE DEVIATION ALARM ACKNOWLEDGED	40266.12
FUEL FILTER PRESSURE DIFFERENTIAL ALARM	40266.13
FUEL FILTER PRESSURE DIFFERENTIAL ALARM ACKNOWLEDGED	40266.14
LUBE OIL FILTER PRESSURE DIFFERENTIAL ALARM	40266.15
LUBE OIL FILTER PRESSURE DIFFERENTIAL ALARM ACKNOWLEDGED	40266.16
ALARM STATUS	40267
PLC MEMORY BATTERY LOW ALARM	40267.01
PLC MEMORY BATTERY LOW ALARM ACKNOWLEDGED	40267.02
SLOT 1 FAULT ALARM	40267.03
SLOT 1 FAULT ALARM ACKNOWLEDGED	40267.04
SLOT 2 FAULT ALARM	40267.05
SLOT 2 FAULT ALARM ACKNOWLEDGED	40267.06
SLOT 3 FAULT ALARM	40267.07
SLOT 3 FAULT ALARM ACKNOWLEDGED	40267.08
SLOT 4 FAULT ALARM	40267.09
SLOT 4 FAULT ALARM ACKNOWLEDGED	40267.10
SLOT 5 FAULT ALARM	40267.11
SLOT 5 FAULT ALARM ACKNOWLEDGED	40267.12
SLOT 6 FAULT ALARM	40267.13
SLOT 6 FAULT ALARM ACKNOWLEDGED	40267.14
SLOT 7 FAULT ALARM	40267.15
SLOT 7 FAULT ALARM ACKNOWLEDGED	40267.16
ALARM STATUS	40268
SLOT 8 FAULT ALARM	40268.01
SLOT 8 FAULT ALARM ACKNOWLEDGED	40268.02
SLOT 9 FAULT ALARM	40268.03
SLOT 9 FAULT ALARM ACKNOWLEDGED	40268.04
RACK 0 GROUP 0 FAULT ALARM	40268.05
RACK 0 GROUP 0 FAULT ALARM ACKNOWLEDGED	40268.06
RACK 0 GROUP 1 FAULT ALARM	40268.07
RACK 0 GROUP 1 FAULT ALARM ACKNOWLEDGED	40268.08
RACK 0 GROUP 2 FAULT ALARM	40268.09
RACK 0 GROUP 2 FAULT ALARM ACKNOWLEDGED	40268.10
RACK 0 GROUP 3 FAULT ALARM	40268.11
RACK 0 GROUP 3 FAULT ALARM ACKNOWLEDGED	40268.12
RACK 0 GROUP 4 FAULT ALARM	40268.13
RACK 0 GROUP 4 FAULT ALARM ACKNOWLEDGED	40268.14
RACK 0 GROUP 5 FAULT ALARM	40268.15
RACK 0 GROUP 5 FAULT ALARM ACKNOWLEDGED	40268.16

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ANALOG DATA	MODBUS ADDRESS
ALARM STATUS	40269
RACK 0 GROUP 6 FAULT ALARM	40269.01
RACK 0 GROUP 6 FAULT ALARM ACKNOWLEDGED	40269.02
RACK 0 GROUP 7 FAULT ALARM	40269.03
RACK 0 GROUP 7 FAULT ALARM ACKNOWLEDGED	40269.04
RACK 1 GROUP 0 FAULT ALARM	40269.05
RACK 1 GROUP 0 FAULT ALARM ACKNOWLEDGED	40269.06
RACK 1 GROUP 4 FAULT ALARM	40269.07
RACK 1 GROUP 4 FAULT ALARM ACKNOWLEDGED	40269.08
RACK 1 GROUP 6 FAULT ALARM	40269.09
RACK 1 GROUP 6 FAULT ALARM ACKNOWLEDGED	40269.10
LUBE OIL TO ENGINE PRESSURE LOW SHUTDOWN	40269.11
LUBE OIL TO ENGINE PRESSURE LOW SHUTDOWN ACKNOWLEDGED	40269.12
JACKET WATER OUTLET TEMPERATURE HIGH SHUTDOWN	40269.13
JACKET WATER OUTLET TEMPERATURE HIGH SHUTDOWN ACKNOWLEDGED	40269.14
REDUNDANT JACKET WATER OUTLET TEMPERATURE HIGH SHUTDOWN	40269.15
REDUNDANT JACKET WATER OUTLET TEMPERATURE HIGH SHUTDOWN ACKNOWLEDGED	40269.16
ALARM STATUS	40270
AUXILIARY #1 TEMPERATURE SHUTDOWN	40270.01
AUXILIARY #1 TEMPERATURE SHUTDOWN ACKNOWLEDGED	40270.02
AUXILIARY #2 TEMPERATURE SHUTDOWN	40270.03
AUXILIARY #2 TEMPERATURE SHUTDOWN ACKNOWLEDGED	40270.04
AUXILIARY #1 4-20 mA SHUTDOWN	40270.05
AUXILIARY #1 4-20 mA SHUTDOWN ACKNOWLEDGED	40270.06
AUXILIARY #2 4-20 mA SHUTDOWN	40270.07
AUXILIARY #2 4-20 mA SHUTDOWN ACKNOWLEDGED	40270.08
NON-DRIVE BEARING TEMPERATURE HIGH SHUTDOWN	40270.09
NON-DRIVE BEARING TEMPERATURE HIGH SHUTDOWN ACKNOWLEDGED	40270.10
DRIVE BEARING TEMPERATURE HIGH SHUTDOWN	40270.11
DRIVE BEARING TEMPERATURE HIGH SHUTDOWN ACKNOWLEDGED	40270.12
ENGINE OVERSPEED SHUTDOWN	40270.13
ENGINE OVERSPEED SHUTDOWN ACKNOWLEDGED	40270.14
CRANKCASE PRESSURE HIGH SHUTDOWN	40270.15
CRANKCASE PRESSURE HIGH SHUTDOWN ACKNOWLEDGED	40270.16
ALARM STATUS	40271
OIL MIST DETECTOR SHUTDOWN	40271.01
OIL MIST DETECTOR SHUTDOWN ACKNOWLEDGED	40271.02
PARTICLE DETECTOR SHUTDOWN	40271.03
PARTICLE DETECTOR SHUTDOWN ACKNOWLEDGED	40271.04
LOW SPEED LOW OIL PRESSURE SHUTDOWN	40271.05
LOW SPEED LOW OIL PRESSURE SHUTDOWN ACKNOWLEDGED	40271.06
HIGH SPEED LOW OIL PRESSURE SHUTDOWN	40271.07
HIGH SPEED LOW OIL PRESSURE SHUTDOWN ACKNOWLEDGED	40271.08
AUXILIARY #1 SHUTDOWN	40271.09
AUXILIARY #1 SHUTDOWN ACKNOWLEDGED	40271.10
AUXILIARY #2 SHUTDOWN	40271.11
AUXILIARY #2 SHUTDOWN ACKNOWLEDGED	40271.12
CUSTOMER SHUTDOWN	40271.13
CUSTOMER SHUTDOWN ACKNOWLEDGED	40271.14
EMERGENCY STOP SHUTDOWN	40271.15
EMERGENCY STOP SHUTDOWN ACKNOWLEDGED	40271.16

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ANALOG DATA	MODBUS ADDRESS
WRITE SPARE	40272
WRITE SPARE	40273
WRITE SPARE	40274
WRITE SPARE	40275
WRITE SPARE	40276
WRITE SPARE	40277
WRITE SPARE	40278
WRITE SPARE	40279
WRITE SPARE	40280
WRITE SPARE	40281
WRITE SPARE	40282
WRITE SPARE	40283
WRITE SPARE	40284
WRITE SPARE	40285
WRITE SPARE	40286
WRITE SPARE	40287
WRITE SPARE	40288
WRITE SPARE	40289
WRITE SPARE	40290
WRITE SPARE	40291
WRITE SPARE	40292
WRITE SPARE	40293
WRITE SPARE	40294
WRITE SPARE	40295
WRITE SPARE	40296
WRITE SPARE	40297
WRITE SPARE	40298
WRITE SPARE	40299
WRITE SPARE	40300
ACKNOWLEDGE ALL READ	40301
ACKNOWLEDGE ALL SIGNAL FROM MODBUS SCADA	40301.01
SPARE	40301.02
SPARE	40301.03
SPARE	40301.04
SPARE	40301.05
SPARE	40301.06
SPARE	40301.07
SPARE	40301.08
SPARE	40301.09
SPARE	40301.10
SPARE	40301.11
SPARE	40301.12
SPARE	40301.13
SPARE	40301.14
SPARE	40301.15
SPARE	40301.16

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ANALOG DATA	MODBUS ADDRESS
READ SPARE	40302
READ SPARE	40303
READ SPARE	40304
READ SPARE	40305
READ SPARE	40306
READ SPARE	40307
READ SPARE	40308
READ SPARE	40309
READ SPARE	40310
READ SPARE	40311
READ SPARE	40312
READ SPARE	40313
READ SPARE	40314
READ SPARE	40315
READ SPARE	40316
READ SPARE	40317
READ SPARE	40318
READ SPARE	40319
READ SPARE	40320
READ SPARE	40321
READ SPARE	40322
READ SPARE	40323
READ SPARE	40324
READ SPARE	40325
READ SPARE	40326
READ SPARE	40327
READ SPARE	40328
READ SPARE	40329
READ SPARE	40330
READ SPARE	40331
READ SPARE	40332
READ SPARE	40333
READ SPARE	40334
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READ SPARE	40336
READ SPARE	40337
READ SPARE	40338
READ SPARE	40339
READ SPARE	40340
READ SPARE	40341
READ SPARE	40342
READ SPARE	40343
READ SPARE	40344
READ SPARE	40345
READ SPARE	40346
READ SPARE	40347
READ SPARE	40348
READ SPARE	40349
READ SPARE	40350

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Packaged Genset Foundation and Mounting

Foundation Design

This section deals with packaged generator set foundations and their relationship to platform framing.

Exact analytical methods cannot always be used to design foundations. The design is also influenced by several factors, including previous successful installations, the designer's experience, and the basic dimensions of the specific package being installed.

C280/3600 packaged generator set weights can vary from 38,900 kg (86,000 lb) for a 6-cylinder, low voltage package with air cooling (excluding radiator weight) up to 95,500 kg (210,000 lb) for a 16-cylinder, high voltage package including a plate-type heat exchanger cooling system and generator forced lubrication module.

The generator set foundation must resist vertical, horizontal and fore-and-aft deflection. If the engine foundation has too little resistance against deflection, it may show up during the alignment of the engines as the mount depressions may be influenced by the combination of foundation deflection and engine forces, and may be out of tolerance.

The generator set foundation must have sufficient rigidity to transmit static and dynamic forces from the package into the foundation.

Mounting

C280/3600 Packaged Offshore Generator Sets are furnished on rigid bases designed by Caterpillar in order to maintain alignment between engine, generator and other engine driven equipment, and must be mounted on spring isolators unless hard mounting has been approved by Caterpillar.

General

All mounting systems must have provisions for alignment retention, collision stops and engine thermal growth.

General Arrangement Drawings

C280-16 Diesel Generator Package General Arrangement Drawings
Note: These drawings are based on the “Rear Mounted Turbocharger Option.”

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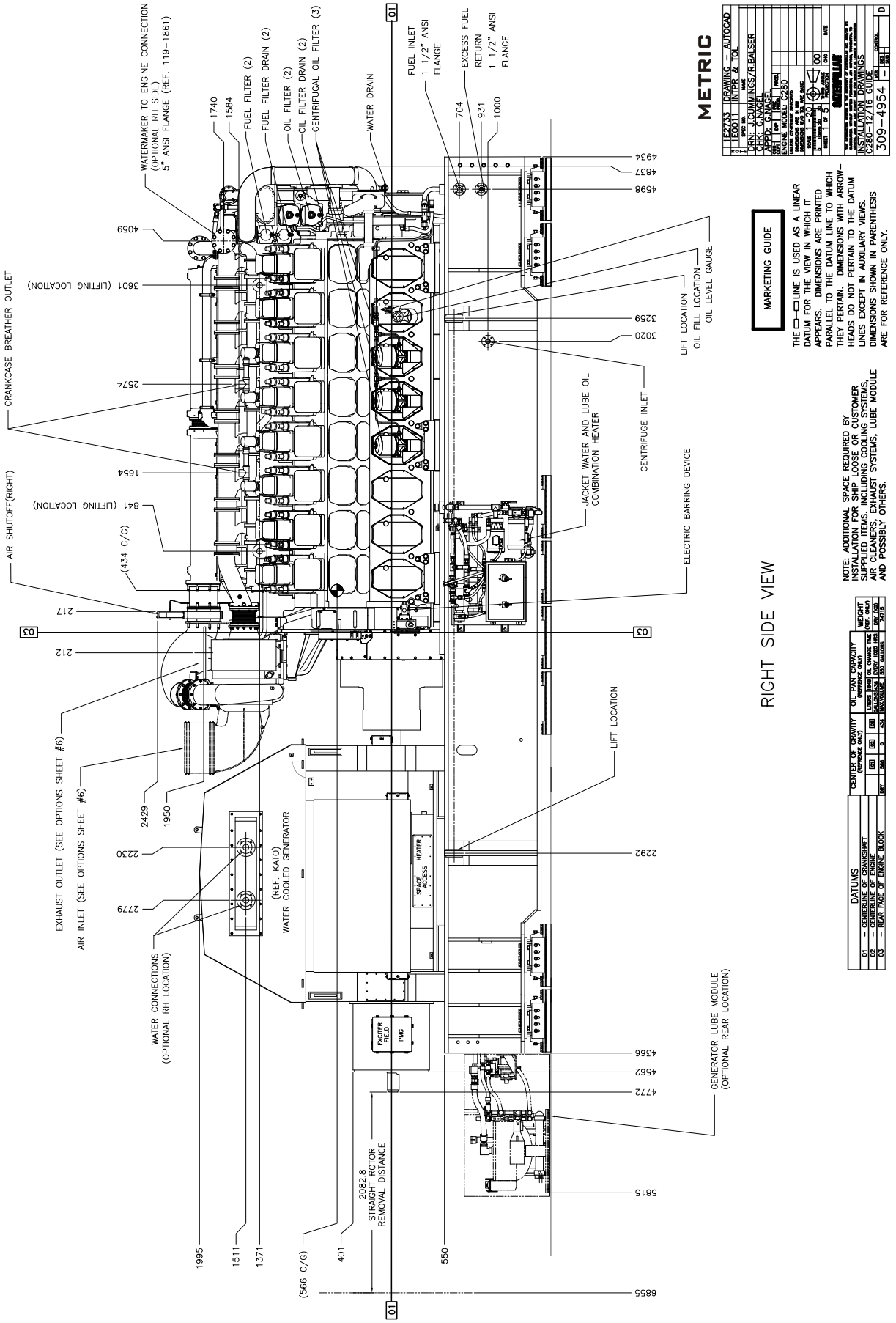
PACKAGED GENSET FOUNDATION AND MOUNTING



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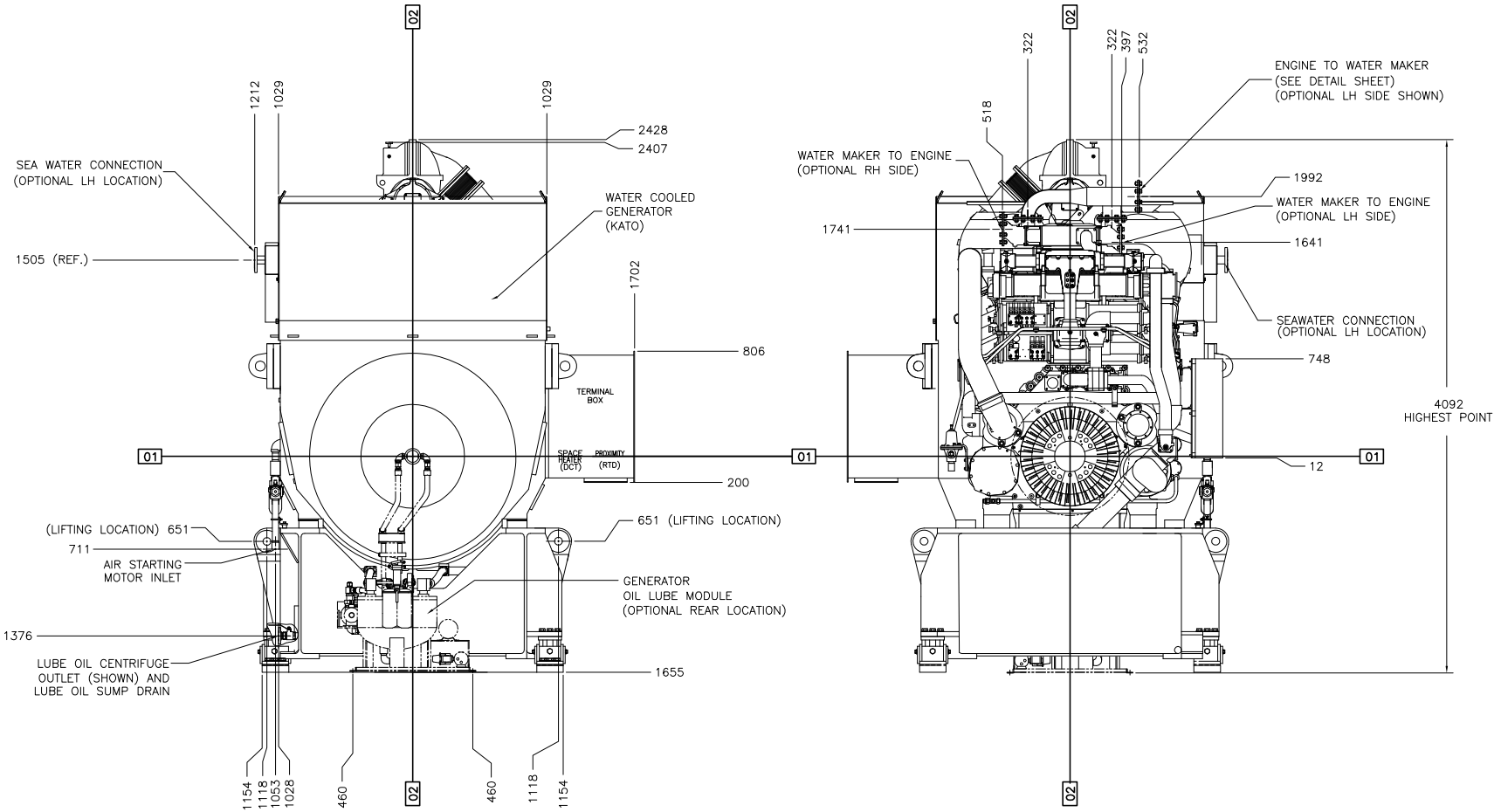

NOTE: DIMENSIONS ON GENERATOR ARE ONLY SPECIFIC TO GENERATOR SHOWN. (KATO)

DATUMS	
01	– CENTERLINE OF CRANKSHAFT
02	– CENTERLINE OF ENGINE
03	– REAR FACE OF CRANKSHAFT ADAPTER

NOTE: ADDITIONAL SPACE REQUIRED BY INSTALLATION FOR SHIP LOOSE OR CUSTOMER SUPPLIED ITEMS. INCLUDING COOLING SYSTEMS, AIR CLEANERS, EXHAUST SYSTEMS, LUBE MODULE AND POSSIBLY OTHERS.

MARKETING GUIDE

THE ⊏—⊐ LINE IS USED AS A LINEAR DATUM FOR THE VIEW IN WHICH IT APPEARS. DIMENSIONS ARE PRINTED PARALLEL TO THE DATUM LINE TO WHICH THEY PERTAIN. DIMENSIONS WITH ARROW-HEADS DO NOT PERTAIN TO THE DATUM LINES EXCEPT IN AUXILIARY VIEWS. DIMENSIONS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY.

METRIC

NOT	1E2733	DRAWING – AUTOCAD
	1E0011	INTPR & TOL
	SPEC NO.	NAME
	DRN: J.CUMMINGS/R.BALSER	
	CHK: G.NAGEL	
	APPD: G.NAGEL	
	CUST DEPT. / EXP / INDUSTRIAL / PROD.	
	ENGINE MODEL: C280	
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC	
	SCALE 1 - 20	00
	SHEET 2 OF 5	THIRD ANGLE PROJECTION / CHG / DATE
	CATERPILLAR®	
	INSTALLATION DRAWINGS	
	C280-12/16 GUIDE	
	309-4954	VER – / DEV / SUB / CONTROL D

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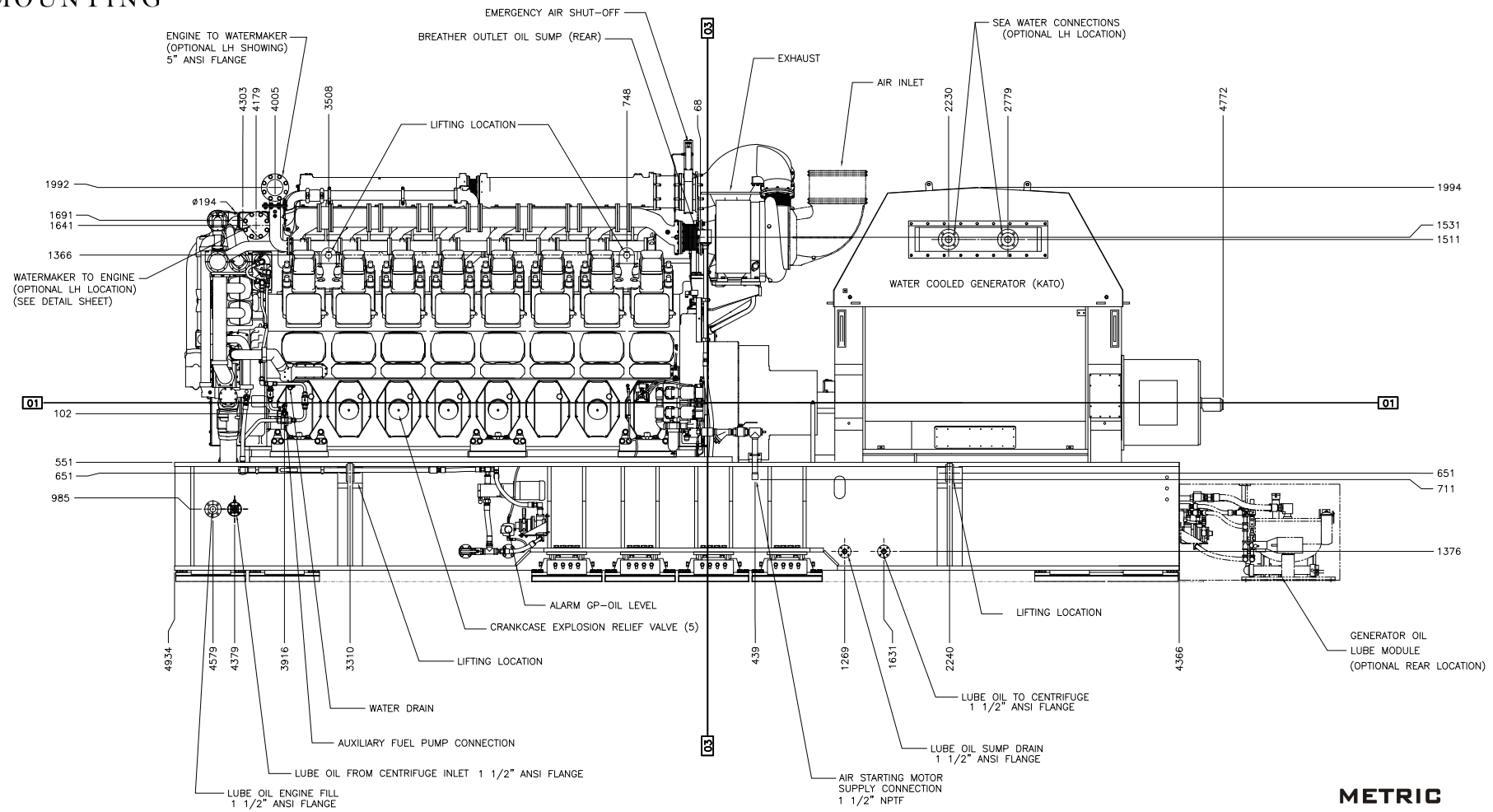
PACKAGED GENSET FOUNDATION AND MOUNTING



LEFT SIDE VIEW

DATUMS		
01	–	CENTERLINE OF CRANKSHAFT
02	–	CENTERLINE OF ENGINE
03	–	REAR FACE OF CRANKSHAFT ADAPTER

NOTE: ADDITIONAL SPACE REQUIRED BY INSTALLATION FOR SHIP LOOSE OR CUSTOMER SUPPLIED ITEMS. INCLUDING COOLING SYSTEMS, AIR CLEANERS, EXHAUST SYSTEMS, LUBE MODULE AND POSSIBLY OTHERS.

MARKETING GUIDE

THE ▭–▭ LINE IS USED AS A LINEAR DATUM FOR THE VIEW IN WHICH IT APPEARS. DIMENSIONS ARE PRINTED PARALLEL TO THE DATUM LINE TO WHICH THEY PERTAIN. DIMENSIONS WITH ARROW–HEADS DO NOT PERTAIN TO THE DATUM LINES EXCEPT IN AUXILIARY VIEWS. DIMENSIONS SHOWN IN PARENTHESIS ARE FOR REFERENCE ONLY.

METRIC

	1E2733	DRAWING – AUTOCAD
REVISE	1E0011	INTPR & TOL
	SPEC NO.	NAME
DRN: J.CUMMINGS/R.BALSER		
CHK: G.NAGEL		
APPD: G.NAGEL		
CONFIG	ENG	PROD
ENGINE MODEL: C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE 1 = 20		
SHEET 3 OF 5	THIRD ANGLE PROJECTION	CHG / DATE

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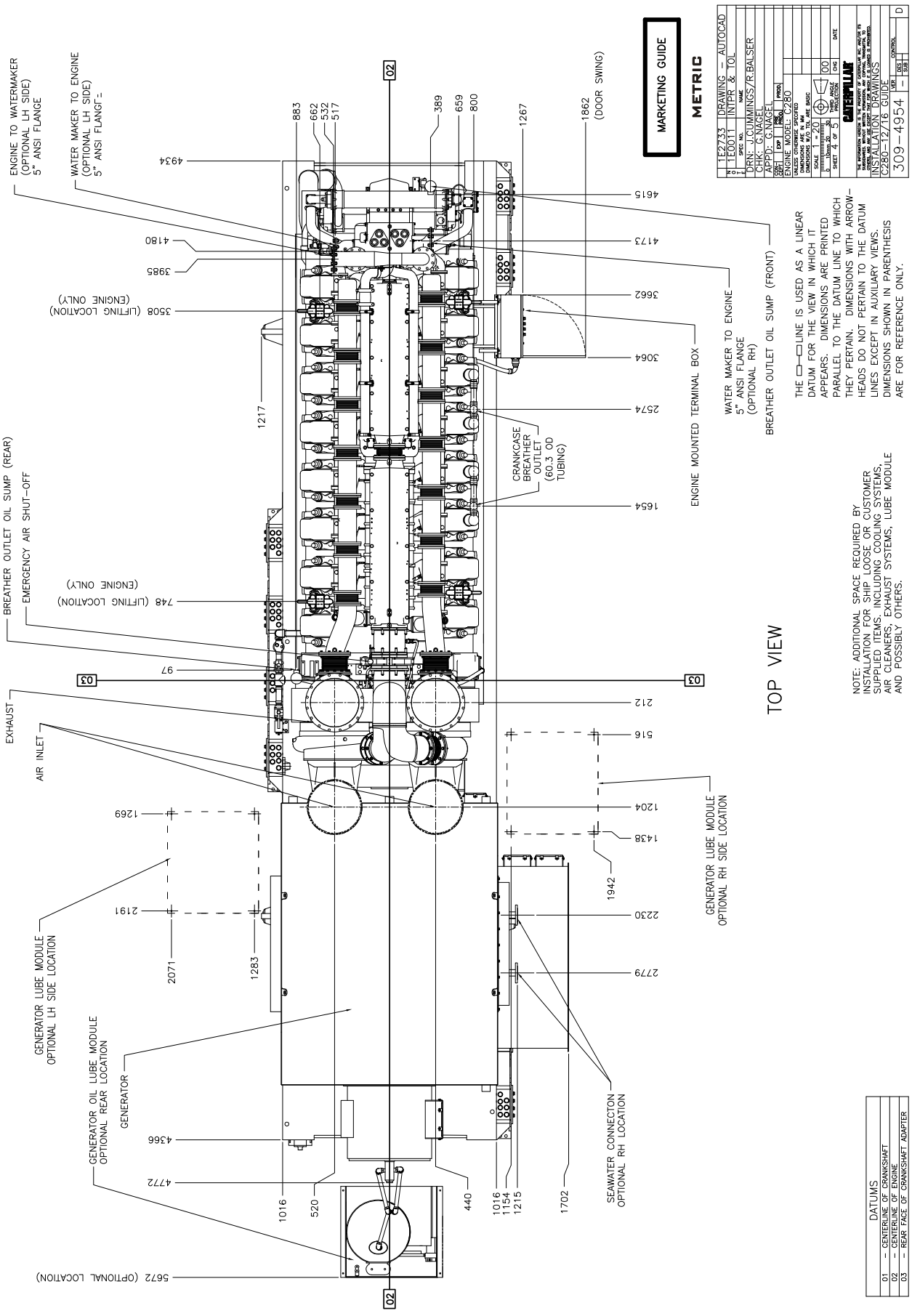

PACKAGED GENSET FOUNDATION AND MOUNTING

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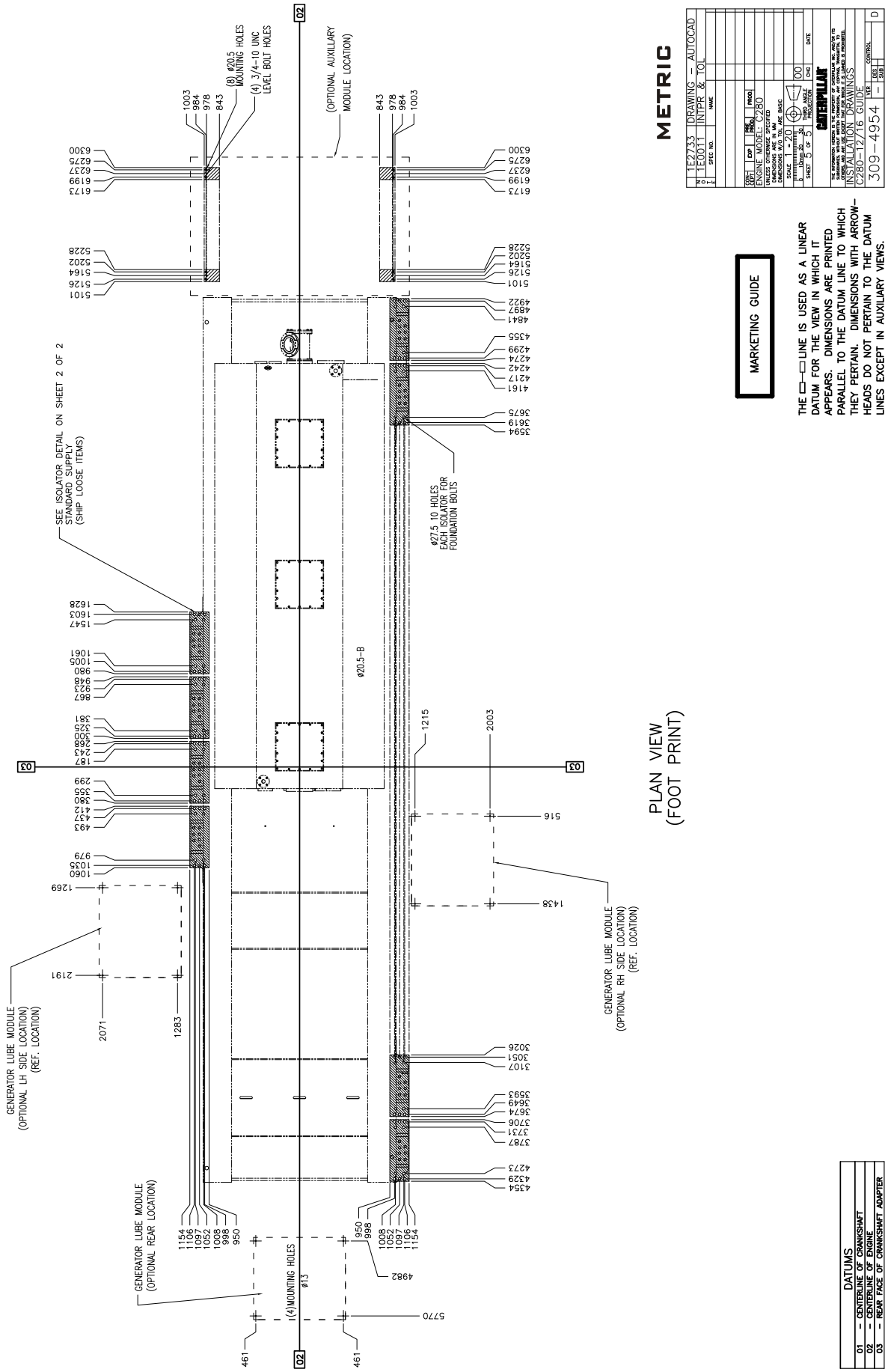
PACKAGED GENSET FOUNDATION AND MOUNTING


PLAN VIEW
(FOOT PRINT)
SEE ISOLATOR DETAIL ON SHEET 2 OF 2
STANDARD SUPPLY
(SHIP LOOSE ITEMS)
(OPTIONAL AUXILLARY
MODULE LOCATION)
(8) ø20.5
MOUNTING HOLES
(4) 3/4-10 UNC
LEVEL BOLT HOLES
ø27.5 10 HOLES
EACH ISOLATOR FOR
FOUNDATION BOLTS
ø20.5-B
GENERATOR LUBE MODULE
(OPTIONAL LH SIDE LOCATION)
(REF. LOCATION)
GENERATOR LUBE MODULE
(OPTIONAL REAR LOCATION)
GENERATOR LUBE MODULE
(OPTIONAL RH SIDE LOCATION)
(REF. LOCATION)
(4) MOUNTING HOLES ø13
DATUMS
01 – CENTERLINE OF CRANKSHAFT
02 – CENTERLINE OF ENGINE
03 – REAR FACE OF CRANKSHAFT ADAPTER
METRIC
MARKETING GUIDE
THE ▭–▭ LINE IS USED AS A LINEAR DATUM FOR THE VIEW IN WHICH IT APPEARS. DIMENSIONS ARE PRINTED PARALLEL TO THE DATUM LINE TO WHICH THEY PERTAIN. DIMENSIONS WITH ARROW-HEADS DO NOT PERTAIN TO THE DATUM LINES EXCEPT IN AUXILIARY VIEWS.
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1E0011 INTPR & TOL
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CONNECTION DATA SHEET

RIGHT HAND SERVICE

	ITEM DESCRIPTION	CONNECTION SPECIFICATIONS	DIMENSIONS 01	02	03	OTHER DETAIL
WATER	WATER CIRCUIT INLET	DETAIL ON 302-6302 SHEET 7 6" ANSI FLANGE	1133	157	6887	PARTNER FLANGE PROVIDED
	WATER CIRCUIT OUTLET	DETAIL ON 302-6302 SHEET 7 6" ANSI FLANGE	650	326	6887	PARTNER FLANGE PROVIDED
	JACKET WATER DRAIN (ACCESSORY MODULE)	3/4-14 NPTF	1239	810	6658	PARTNER FLANGE NOT NEEDED
	SCAC WATER DRAIN (ACCESSORY MODULE)	3/4-14 NPTF	1242	413	6673	PARTNER FLANGE NOT NEEDED
	WATERMAKER INLET	DETAIL ON 302-6302 SHEET 7 4" ANSI FLANGE	917	326	6375	PARTNER FLANGE PROVIDED
	WATERMAKER OUTLET	DETAIL ON 302-6302 SHEET 7 4" ANSI FLANGE	1133	326	6123	PARTNER FLANGE PROVIDED
	GENERATOR COOLING INLET	DN50, PN16, DIN 2633 FLANGE	945	1040	1912	PARTNER FLANGE NOT PROVIDED
	GENERATOR COOLING OUTLET	DN50, PN16, DIN 2633 FLANGE	1595	1040	1912	PARTNER FLANGE NOT PROVIDED
FUEL	FUEL INLET	DETAIL ON 302-6302 SHEET 7 1 1/2" ANSI FLANGE	705	980	4598	PARTNER FLANGE NOT PROVIDED
	EXCESS FUEL RETURN	DETAIL ON 302-6302 SHEET 7 1 1/2" ANSI FLANGE	932	980	4598	PARTNER FLANGE NOT PROVIDED
	AUXILIARY FUEL PUMP CONNECTION	1 5/16-12 THD	12	573	3916	PARTNER FLANGE NOT NEEDED
OIL	CENTRIFUGE INLET	DETAIL ON 302-6302 SHEET 7 1 1/2" ANSI FLANGE	985	1046	4379	PARTNER FLANGE NOT PROVIDED
	CENTRIFUGE OUTLET	DETAIL ON 302-6302 SHEET 7 1 1/2" ANSI FLANGE	1445	1028	2316	PARTNER FLANGE NOT PROVIDED
AIR	EXHAUST (RIGHT)	DETAIL ON 302-6302 SHEET 6 PART #2W-2682	2714	440	212	PARTNER FLANGE PROVIDED
	EXHAUST (LEFT)	DETAIL ON 302-6302 SHEET 6 PART #2W-2682	2714	520	212	PARTNER FLANGE PROVIDED
	CRANKCASE BREATHER OUTLET (FRONT)	FOR 60.3 OD TUBING	1584	800	2574	PARTNER FLANGE NOT NEEDED
	CRANKCASE BREATHER OUTLET (REAR)	FOR 60.3 OD TUBING	1584	800	1654	PARTNER FLANGE NOT NEEDED

NOTE: THE DATA IN THIS CHART IS FOR MARKETING GUIDE USE ONLY.

METRIC

	1E2733	DRAWING – AUTOCAD
NOTE	1E0011	INTPR & TOL
	SPEC NO.	NAME
CON-CEPT / EXP / PRE-PROD / PROD.		
ENGINE MODEL: C280-16		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE 1 – 20		
0 10mm 20 30	00	
SHEET 1 OF 1	THIRD ANGLE PROJECTION	CHG / DATE

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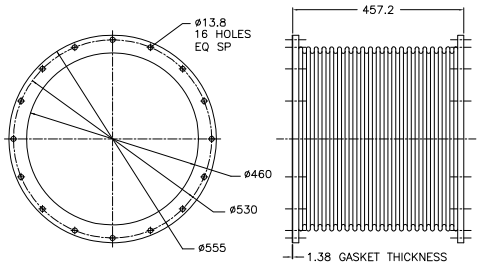
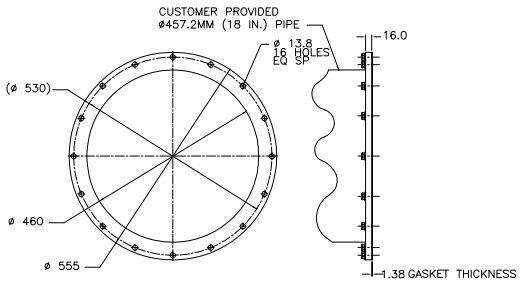
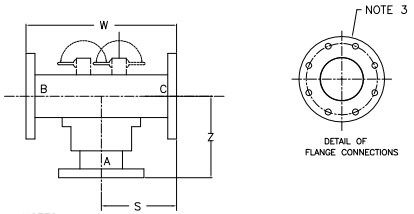
STANDARD SUPPLY
SHIPPED LOOSE ITEMS
SHEET 1 OF 2



DETAIL OF 2W-7889 EXHAUST BELLOWS
(457.2 / 18 IN. PIPE)
(ATT DIM DWG #7E-6282)
SCALE NONE



DETAIL OF 2W2682 EXHAUST FLANGE (18 INCH)
(ATT DIM DWG # 7E6228)
SCALE NONE



NOTES:

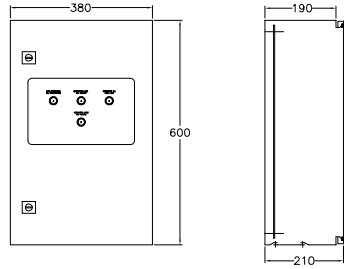
1. THIS DRAWING IS REPRESENTITIVE OF THE AC/OC THERMOSTATIC VALVE.
2. THE MAXIMUM ALLOWABLE PRESSURE DROP FOR THE EXTERNAL COOLING SYSTEM SHALL NOT EXCEED: AC/OC SYSTEM – 84 kPa ±10%
3. FLANGES SHALL BE PER THE REQUIREMENTS OF ANSI B16.1 (125# CLASS) "FF FLANGES"

SIZE	"S"	"W"	"Z"	"A"	"B"	"C"
5"	249	489	241	5" ANSI	5" ANSI	5" ANSI

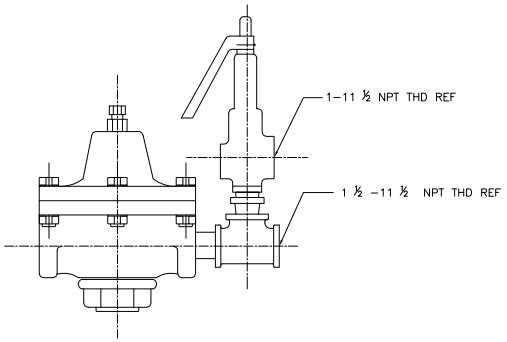
THERMOSTATIC VALVE CONNECTIONS:

A = INLET
B = BYPASS
C = HEAT EXCHANGER

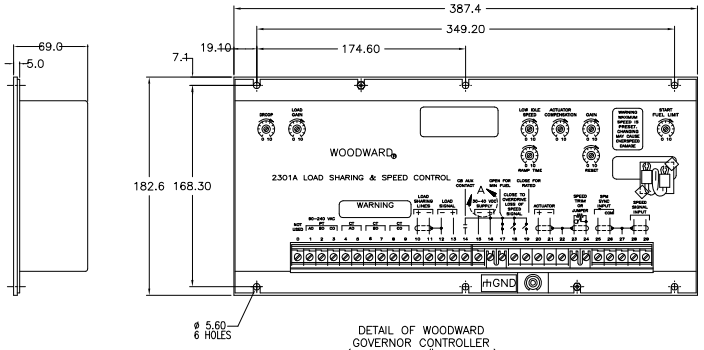
DETAIL OF PART NO. 149-7709
(AMOT THERMOSTATIC VALVE PART NO. 5BMCF09007)
(5 INCH)
SCALE NONE



DETAIL OF PART #211-2710 BOX GP-JUNCTION
(GENERATOR PRELUBE SYSTEM)
(SHIPPED LOOSE)
SCALE NONE



DETAIL OF PART #9y-9589 AIR PREASSURE REGULATOR
SCALE NONE



DETAIL OF WOODWARD
GOVERNOR CONTROLLER
(ATT DIM DWG# 7E-6928)

ITEMS NOT MARKED (SHIPPED LOOSE)
ARE MOUNTED PRIOR TO SHIPMENT

METRIC

	1E2733	DRAWING – AUTOCAD
DOC	1E0011	INTPR & TOL
	SPEC NO.	NAME
DRN: J.D.C./R.F.B.		
CHK: G. NAGEL		
APP'D: G. NAGEL		
CONF	EXP	PRE-PROD	PROD
ENGINE MODEL: C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE – –		
0 10mm 20 30	THIRD ANGLE PROJECTION	00 CHG DATE
SHEET 1 OF 2		

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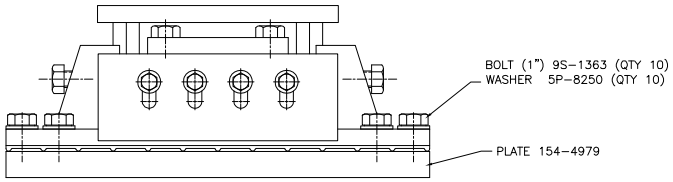
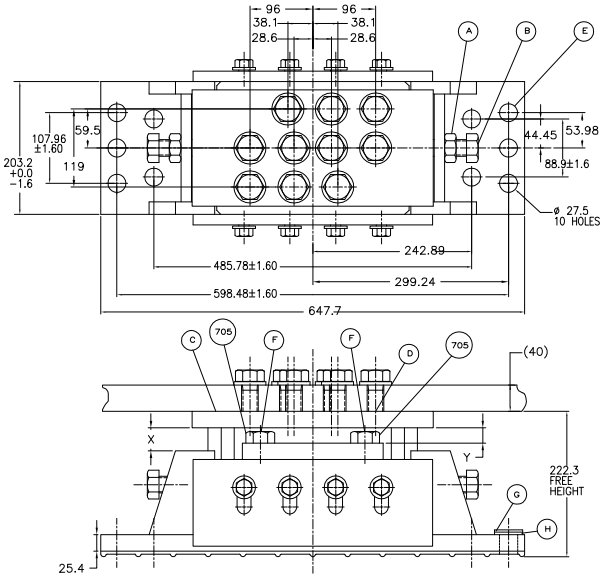
STANDARD SUPPLY
SHIPPED LOOSE ITEMS
SHEET 2 OF 2



DETAIL OF 160-3655 SHIPPED LOOSE MOBILE ISOLATOR MOUNTING GP (QTY 8)

SCALE NONE



DETAIL OF 7C-6537 SHIPPED LOOSE MOBILE ISOLATOR
(ATT DIM DWG #7E-6938)

SCALE NONE

STIFFNESS FACTOR

	METRIC	(INCH)
K =	618.6 KG/mm	(34,640.0 LBS/IN)

INSTALLATION INSTRUCTIONS FOR ISOLATORS

INSTALLATION

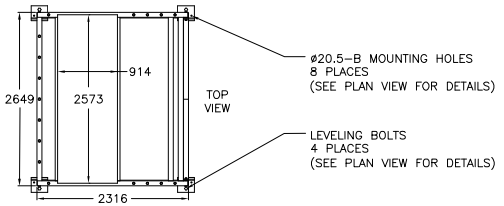
1. SHIM OR GROUT, IF REQUIRED, TO PROVIDE FLAT SURFACE FOR ISOLATOR. ISOLATOR CAN TOLERATE 6.35 MM (0.25 IN.) DIFFERENCE IN ELEVATION DUE TO VARIATION IN FLOOR GRADE.
2. LOOSEN NUT "A" AND BOLT "B" SEVERAL TURNS, UNTIL SNUBBERS ARE NOT BINDING.
3. PLACE BASE ON ISOLATORS AND BOLT TO ISOLATION TOP PLATE "C" THROUGH MOUNTING HOLE "D". BOLT MUST NOT PROJECT BELOW LOWER SURFACE OF TOP PLATE "C".
4. ALIGN FLAT STEEL WASHER (G) AND FABRIC REINFORCED WASHER (H) AS SHOWN AND TIGHTEN ANCHOR BOLTS OR NUTS THROUGH ANCHOR BOLT HOLE "E" TO SECURE ISOLATORS TO SUB-STRUCTURE.

ADJUSTMENT PROCEDURE FOR SI ISOLATORS

5. IF CLEARANCE AT "X" IS LESS THAN 6.35 MM (0.25 IN.) ON ANY ISOLATOR, TURN DOWN LEVELING BOLT "F" OF EACH ISOLATOR TWO TURNS, MAKING A COMPLETE CIRCUIT OF ALL ISOLATORS. REPEAT THIS PROCEDURE UNTIL ALL ISOLATORS HAVE AT LEAST 6.35 MM (0.25 IN.) CLEARANCE AT "X". OMIT THIS STEP IF "X" IS OR EXCEEDS 6.35 mm (0.25 IN.).
6. IF EQUIPMENT IS NOT LEVEL AFTER STEP NO. 5, TURN DOWN BOLTS "F" AT LOW END OF ENGINE UNTIL LEVEL.
INCREASE HEIGHT OF ENGINE, IF REQUIRED, TO MEET CONNECTIONS, BY TURNING DOWN LEVELING BOLTS "F" ON ALL ISOLATORS THE SAME NUMBER OF TURNS.
7. IF THE FLOOR IS LEVEL UNDER A GIVEN SPRING ISOLATOR CLUSTER, ALL ISOLATORS WITHIN THE CLUSTER SHOULD HAVE THE "Y" DIMENSION WITHIN ±10% OF EACH OTHER. THIS EQUALIZES THE LOAD EACH SPRING ISOLATOR SUPPORTS.

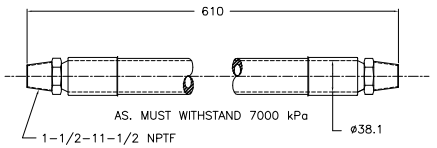
HORIZONTAL CHOCK ADJUSTMENT

8. START UP ENGINE. TIGHTEN BOLT "B" AT EACH END OF EACH ISOLATOR UNTIL FINGER TIGHT.
9. TIGHTEN LOCKNUT "A" AND INSTALLATION IS COMPLETE.
10. IT IS NORMAL FOR MOTION OF THE ENGINE TO INCREASE DURING START-UP AND SHUT-DOWN. SHOULD THIS MOTION BE INTOLERABLE, TIGHTEN BOLT "B" SLIGHTLY. HOWEVER, THIS REDUCES ISOLATOR EFFICIENCY AND MUST ONLY BE DONE WHEN ABSOLUTELY NECESSARY.



DETAIL OF PART #230-0095 ACCESSORY MODULE AS.
(SHIPPED LOOSE)

SCALE NONE



DETAIL OF 4P-4113 HOSE ASSEMBLY
FOR AIR STARTING MOTOR INLET

SCALE NONE

NOTE: ITEMS NOT MARKED (SHIPPED LOOSE)
ARE MOUNTED PRIOR TO SHIPMENT

METRIC

1E2733	DRAWING - AUTOCAD	
1E0011	INTPR & TOL	
SPEC NO.	NAME	
DRN: J.D.C./R.F.B.		
CHK: G. NAGEL		
APPD: G. NAGEL		
CONT: ENG / MFG / PROD		
ENGINE MODEL:C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE - - -		
SHEET 2 OF 2	THIRD ANGLE PROJECTION	00
CAGE	DATE	
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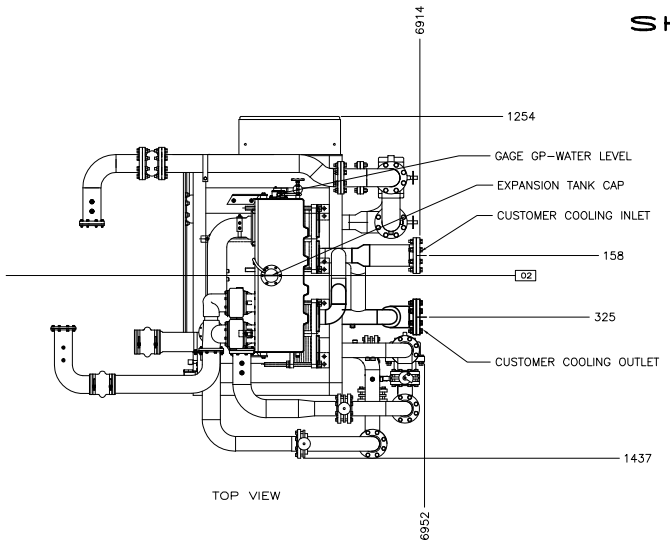
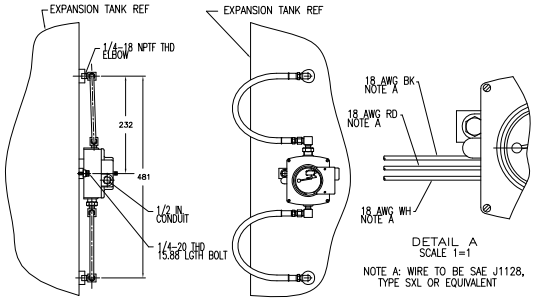
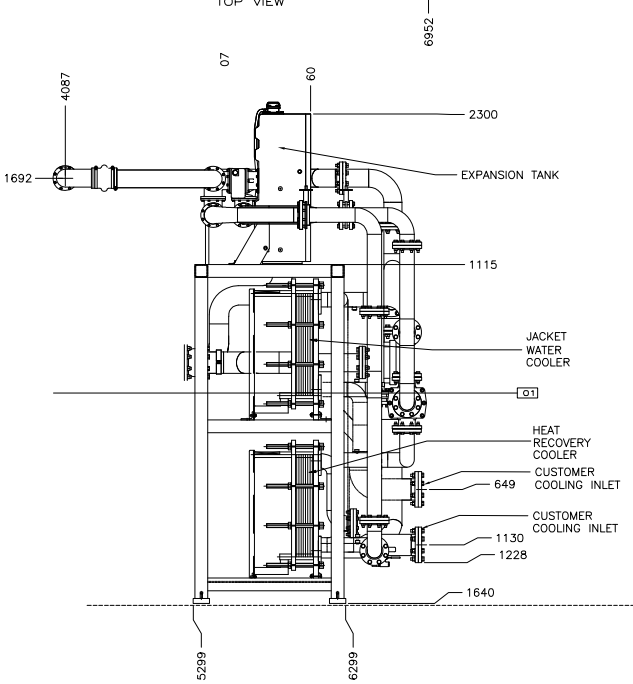
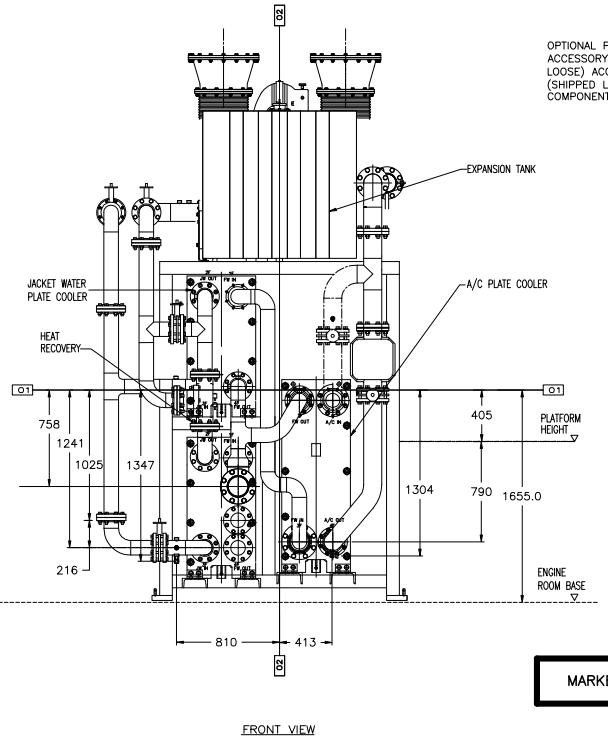
OPTIONAL ITEMS
SHEET 1 OF 4




EXPANSION TANK REF
EXPANSION TANK REF
1/4–18 NPTF THD ELBOW
232
481
1/2 IN. CONDUIT
1/4–20 THD 15.88 LGTH BOLT
18 AWG BK NOTE A
18 AWG RD NOTE A
18 AWG WH NOTE A
DETAIL A SCALE 1=1
NOTE A: WIRE TO BE SAE J1128, TYPE SXL OR EQUIVALENT
DETAIL OF 7N4885 GAGE GP–LEVEL (REF. DIM DWG # 7E6958) SCALE NONE





OPTIONAL PACKAGE MOUNTED ACCESSORY MODULE, (SHIPPED LOOSE) ACCESSORY MODULE OR (SHIPPED LOOSE) COOLING SYTEM COMPONENTS

OPTION KITS (NOT SHOWN ON DRAWINGS)		
ITEM	DESCRIPTION	MATERIAL #
1	AIR / EXHAUST	SPPKT33
2	EXH ELBOWS	SPPKT37
3	BASIC ENGINE KIT	SPPKT40
4	PISTON ASSY.	SPPKT41
5	CUFFED LINER	SPPKT42
6	BEARING SPARE PARTS	SPPKT43
7	ROD ASSY.	SPPKT44
8	HEAD – COMMON	SPPKT46
9	GASKETS	SPPKT50
10	COOLING SYTEM	SPPKT54
11	INSRT – DIST FUEL	SPPKT55
12	VALVE – DIST FUEL	SPPKT57
13	FUEL – COMMON	SPPKT74
14	INJECTOR – COMMON	SPPKT75
15	MAN SRV PMP – TOOLING	TOL0552
16	TURBOCHARGER TOOL	TOL3703
17	CYL. HEAD TOOL	TOOL005
18	PROTECT. SYST. CALIBRATOR	TOOL013
19	OIL MIST DET. TOOL	TOOL018
20	GENERATOR SPARE PARTS	OV2319

NOTE: ITEMS NOT MARKED (SHIPPED LOOSE) ARE MOUNTED PRIOR TO SHIPMENT

METRIC

	1E2733	DRAWING – AUTOCAD
NOT	1E0011	INTPR & TOL
	SPEC NO.	NAME
DRN: J.D.C./R.F.B.		
CHK: G. NAGEL		
APPD: G. NAGEL		
CON. DEPT	EXP	REL PROD. PROD.
ENGINE MODEL: C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE – = –		
0 10mm 20 30	THIRD ANGLE PROJECTION	00
SHEET 1 OF 4		CHG DATE

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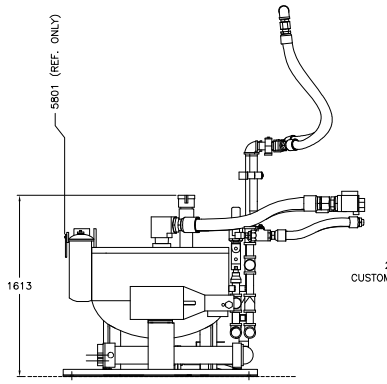
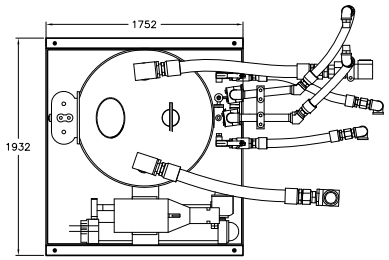
OPTIONAL ITEMS
SHEET 2 OF 4

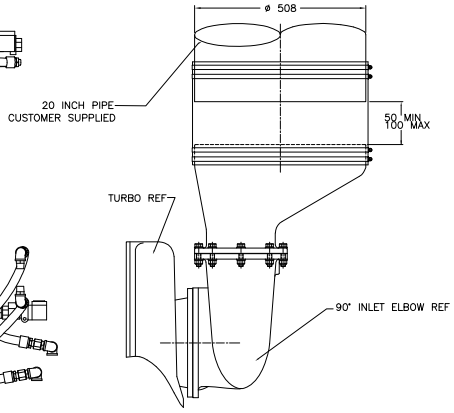


RIGHT VIEW

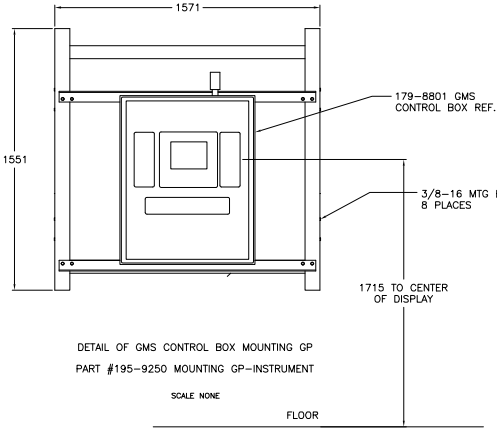


REAR VIEW

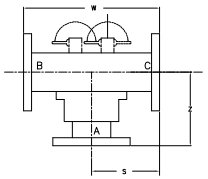
DETAIL OF OIL LUBE MODULE



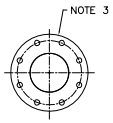
DETAIL OF 4W3618 ADAPTER GP AIR CLEANER
(ATT DIM DWG # 7E6921)
(SHIPPED LOOSE)
SCALE NONE



DETAIL OF GMS CONTROL BOX MOUNTING GP
PART #195-9250 MOUNTING GP-INSTRUMENT
SCALE NONE



THERMOSTATIC VALVE.



DETAIL OF
FLANGE CONNECTIONS

THERMOSTATIC VALVE
CONNECTIONS:

A = INLET
B = BYPASS
C = HEAT EXCHANGER

NOTES:
1. THIS DRAWING IS REPRESENTATIVE OF THE AC/OC
2. THE MAXIMUM ALLOWABLE PRESSURE DROP FOR THE EXTERNAL COOLING SYSTEM SHALL NOT EXCEED: AC/OC SYSTEM – 84 kPa ±10%
3. FLANGES SHALL BE PER THE REQUIREMENTS OF ANSI B16.1 (125# CLASS) "FF FLANGES"

SIZE	"S"	"W"	"Z"	"A"	"B"	"C"
5"	249	489	241	5" ANSI	5" ANSI	5" ANSI

DETAIL OF PART NO. 149-7709
(AMOT THERMOSTATIC VALVE PART NO. 5BMCF09007)
(5 INCH)
SCALE NONE

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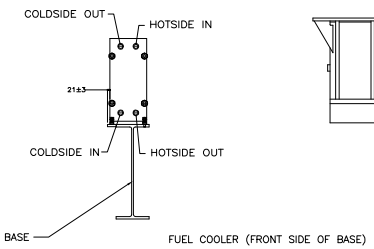
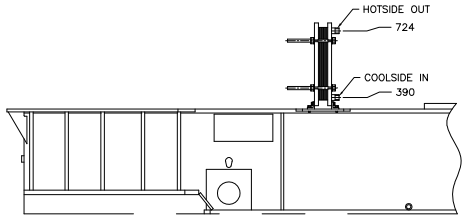
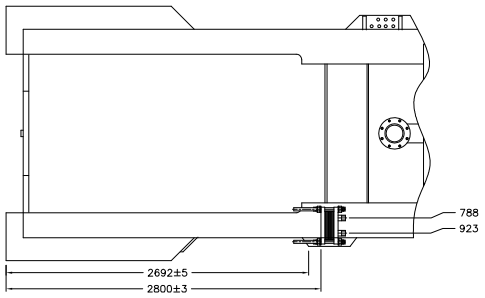


FUEL COOLER (FRONT SIDE OF BASE)



FUEL COOLER (RIGHT SIDE OF BASE)



FUEL COOLER (TOP SIDE OF BASE)

METRIC

	1E2733	DRAWING – AUTOCAD	
DOT	1E0011	INTPR & TOL	
	SPEC NO.	NAME	
DRN: J.D.C./R.F.B.			
CHK: G. NAGEL			
APPD: G. NAGEL			
ENGINE MODEL:C280			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC			
SCALE – = –		00	
SHEET 2 OF 4	THIRD ANGLE PROJECTION	CHG	DATE

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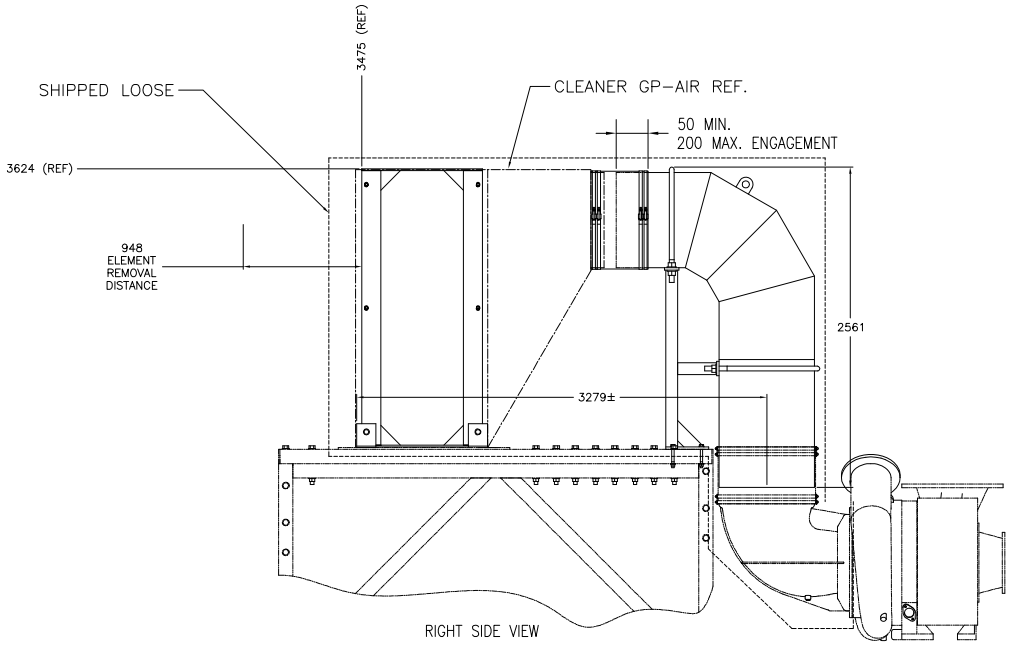
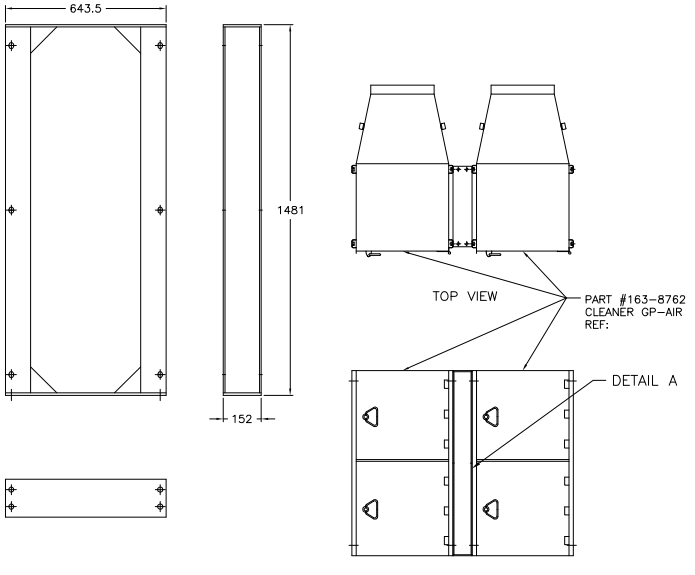
PACKAGED GENSET FOUNDATION AND MOUNTING

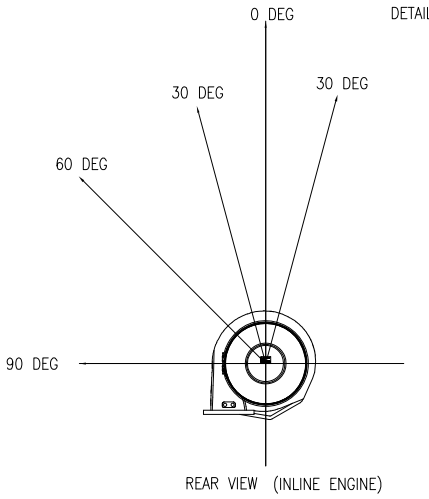
OPTIONAL ITEMS
SHEET 3 OF 4



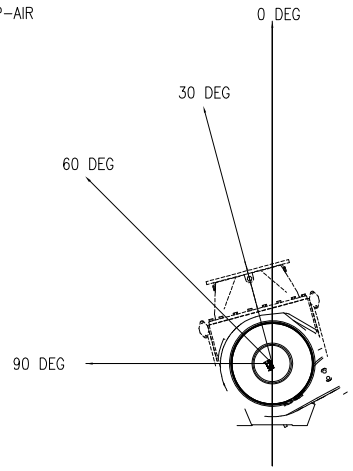


DETAIL A

DETAIL OF PART #161–7057
AIR CLEANER MOUNTING GROUP
(SHIPPED LOOSE)
SCALE NONE



DETAILS OF PART #309–1804 LINES GP–AIR
SCALE NONE
(SHIPPED LOOSE)



NOTE: ITEMS NOT MARKED (SHIPPED LOOSE)
ARE MOUNTED PROIR TO SHIPMENT

1E2733	DRAWING – AUTOCAD	
1E0011	INTPR & TOL	
SPEC NO.	NAME	
DRN: J.D.C./R.F.B.		
CHK: G. NAGEL		
APPD: G. NAGEL		
ENGINE MODEL: C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE – = –		00
SHEET 3 OF 4	THIRD ANGLE PROJECTION	CHG / DATE

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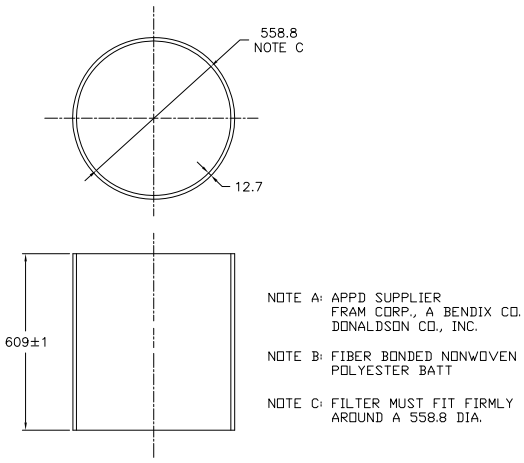
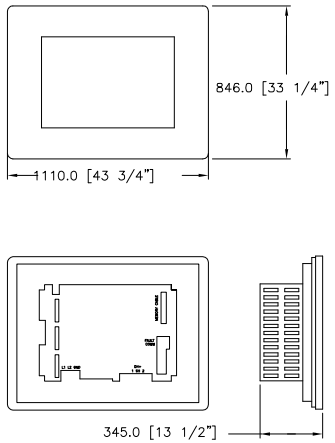
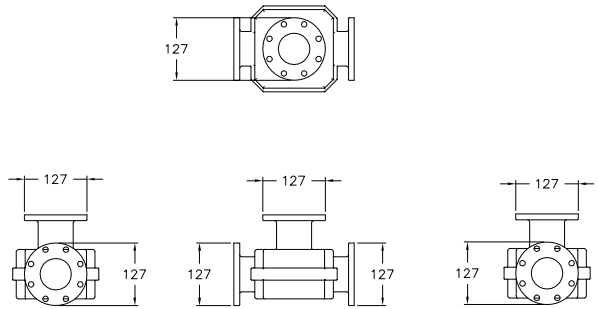
OPTIONAL ITEMS
SHEET 4 OF 4



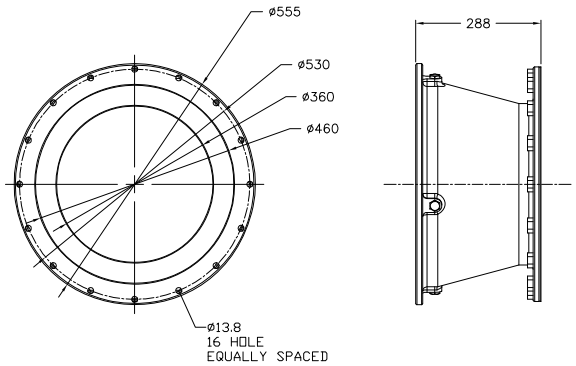
DETAIL OF 4W7103 FILTER - SOOT
SCALE NONE



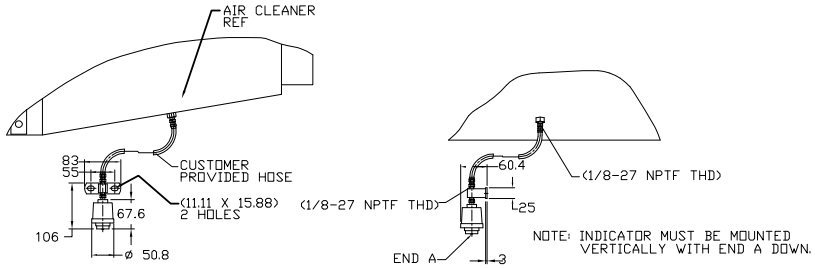
DETAIL OF 179-8850 MONITOR ASSEMBLY
SCALE = NONE



DETAIL OF PART #191-9116 VALVE GP-THRMSTC
(5" 150# ANSI FLAT FACE WELD FLANGE)
SCALE NONE



DETAIL OF PART #166-2166 EXHAUST FITTING
SCALE NONE



DETAIL OF PART #4W-5982 GAGE GP-AIR CLEANER
(ATT DIM DWG #7E-7046)
SCALE NONE

NOTE: ITEMS NOT MARKED (SHIPPED LOOSE)
ARE MOUNTED PRIOR TO SHIPMENT

METRIC

NOT USED	1E2733	DRAWING - AUTOCAD
	1E0011	INTPR & TOL
	SPEC NO.	NAME
DRN: J.D.C./R.F.B.		
CHK: G. NAGEL		
APPD: G. NAGEL		
DSN: 2021	ENG	PUB: 2009 PROD
ENGINE MODEL: C280		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM DIMENSIONS W/O TOL ARE BASIC		
SCALE - = -		
0 10mm 50	THIRD ANGLE PROJECTION	00
SHEET 4 OF 4	CHG	DATE

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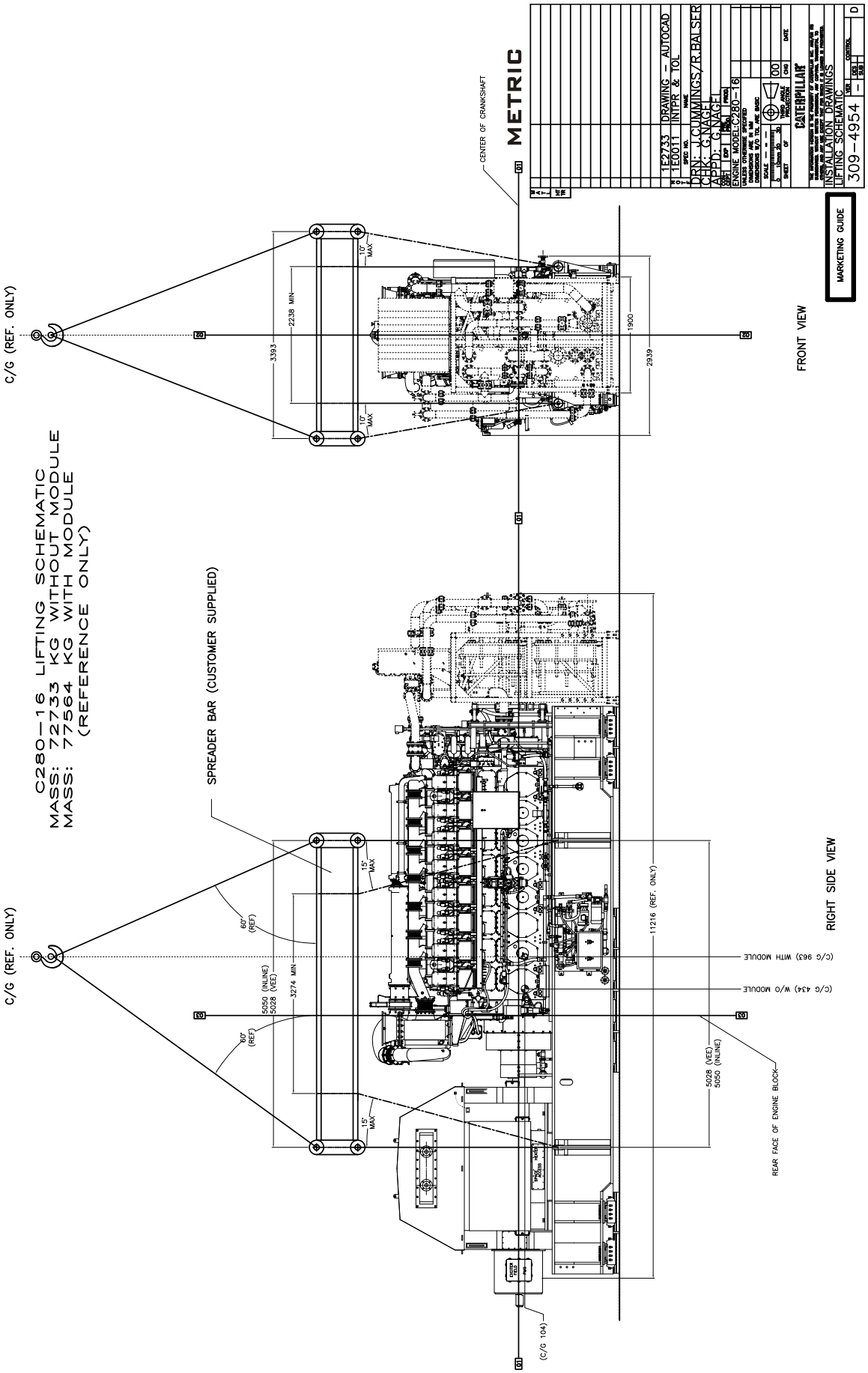

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Miscellaneous

Engine Weights

The following weight schedule lists the weights of the C280/3600 series engines and optional supplied items. Select the optional items and add to the engine dry weight to estimate the weight of an engine shipset. Generator set package weights vary as discussed on page 131.

C280/3600 Engine Weights kg (lb)				
Engine Model	**C280-6 3606**	**C280-8 3608**	**C280-12 3612**	**C280-16 3616**
Engine Dry Weight (See Note below)	15,680 (34,568)	25,980 (57,276)	19,000 (41,888)	31,000 (68,343)
Optional Supplied Items:				
Torsional Coupling	319 (703)	420 (926)	319 (703)	480 (1,058)
Plate Type, Heat Exchanger	250 (551)	300 (661)	275 (606)	375 (827)
Water Temperature Regulator	86 (190)	86 (190)	86 (190)	86 (190)
Primary Fuel Strainer	11 (24)	11 (24)	11 (24)	11 (24)
Pressure Reduction Valve	20 (44)	20 (44)	20 (44)	20 (44)
Freshwater Expansion Tank	135 (298)	135 (298)	135 (298)	135 (298)
Exhaust Pieces: (Turbocharger Adapter, Bellows, Expander to 18 inch)	134 (295)	268 (591)	134 (295)	268 (591)
Fluids Weights:				
Lube Oil @ (.9097 kg/liter)	634 (1,398)	828 (1,825)	691 (1,523)	961 (2,119)
Freshwater Coolant	400 (882)	800 (1,764)	530 (1,168)	1060 (2,337)
Heat Exchanger (FW & SW)	70 (154)	80 (176)	70 (154)	133 (293)
Total Weight per Engine				
Note: “Engine Dry Weight” consists of the following engine mounted items: a one piece, gray iron cylinder block, governor actuator, two freshwater pumps, one sea water pump, one lube oil filter, fuel and lube oil duplex filters, centrifugal lube oil filters, electric prelube pump, exhaust shielding, intake air silencer, air starting motors, barring device, oil mist detector, flywheel and 6 x anti-vibration mounts.				

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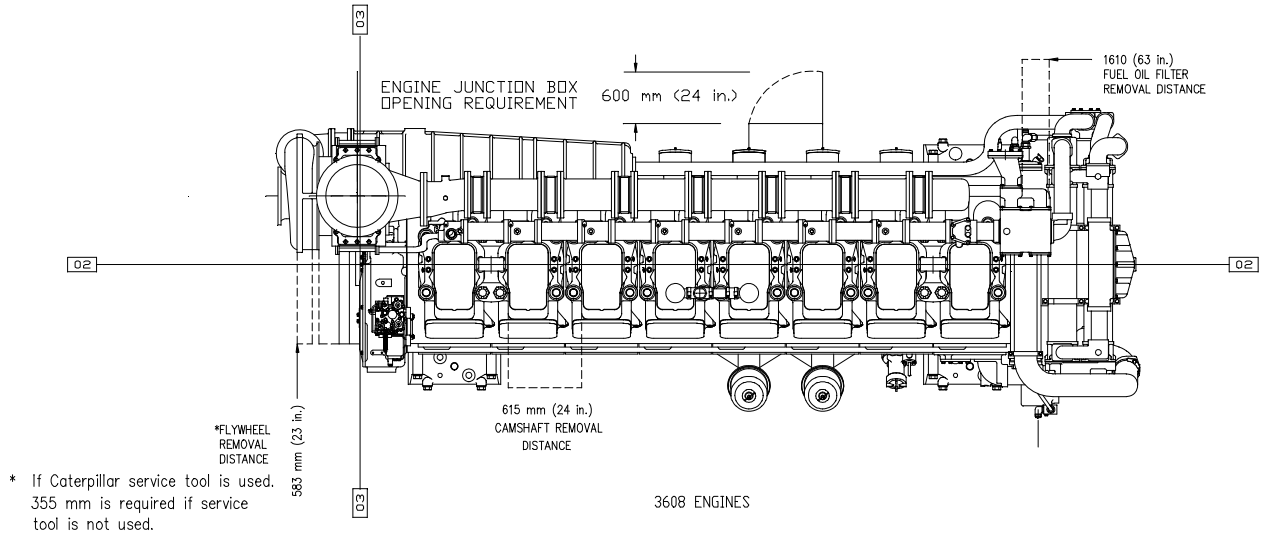
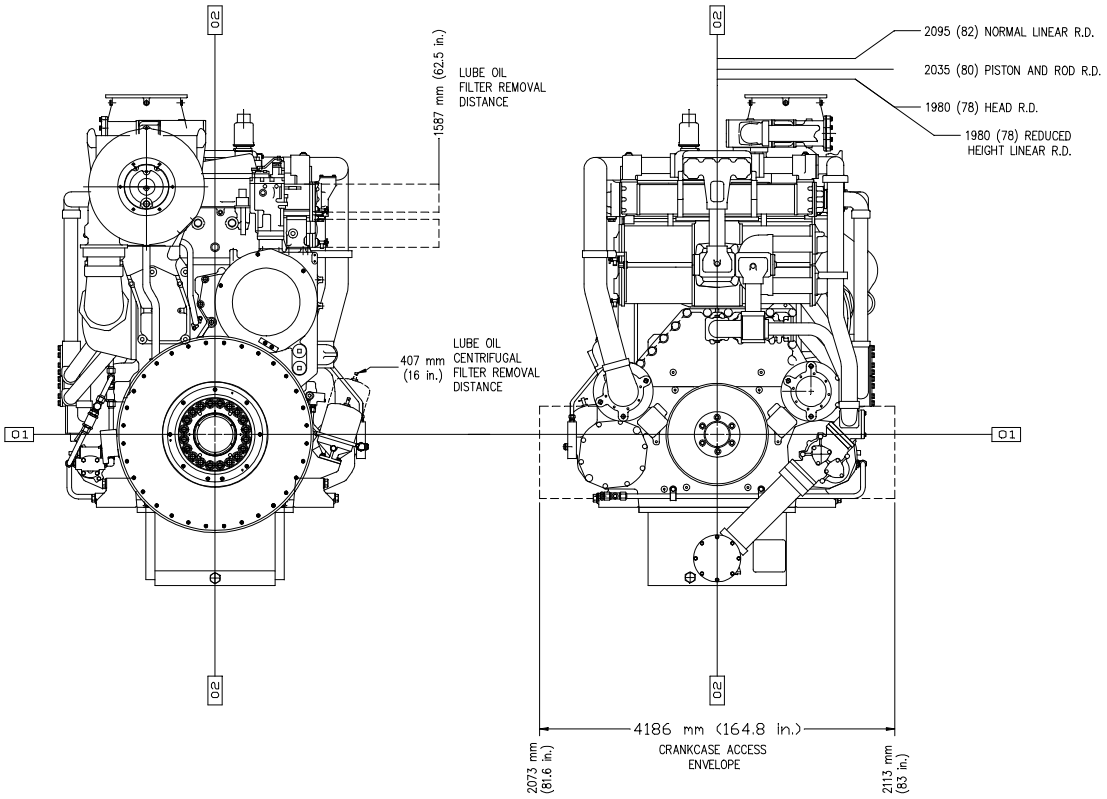


* If Caterpillar service tool is used. 355 mm is required if service tool is not used.

3608 ENGINES



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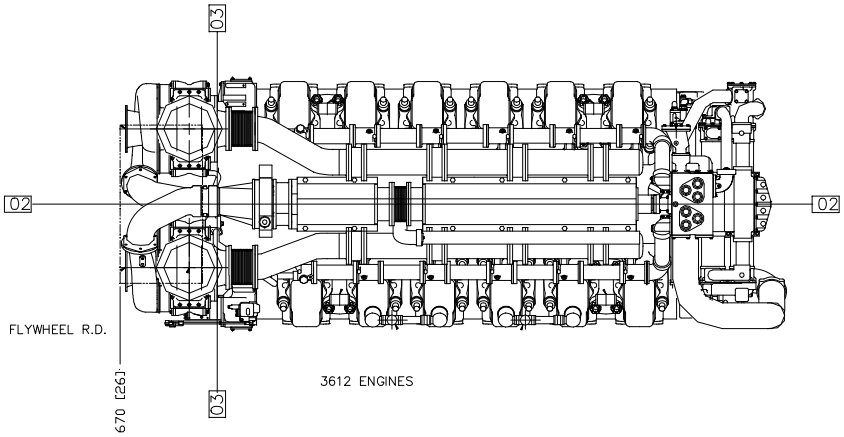
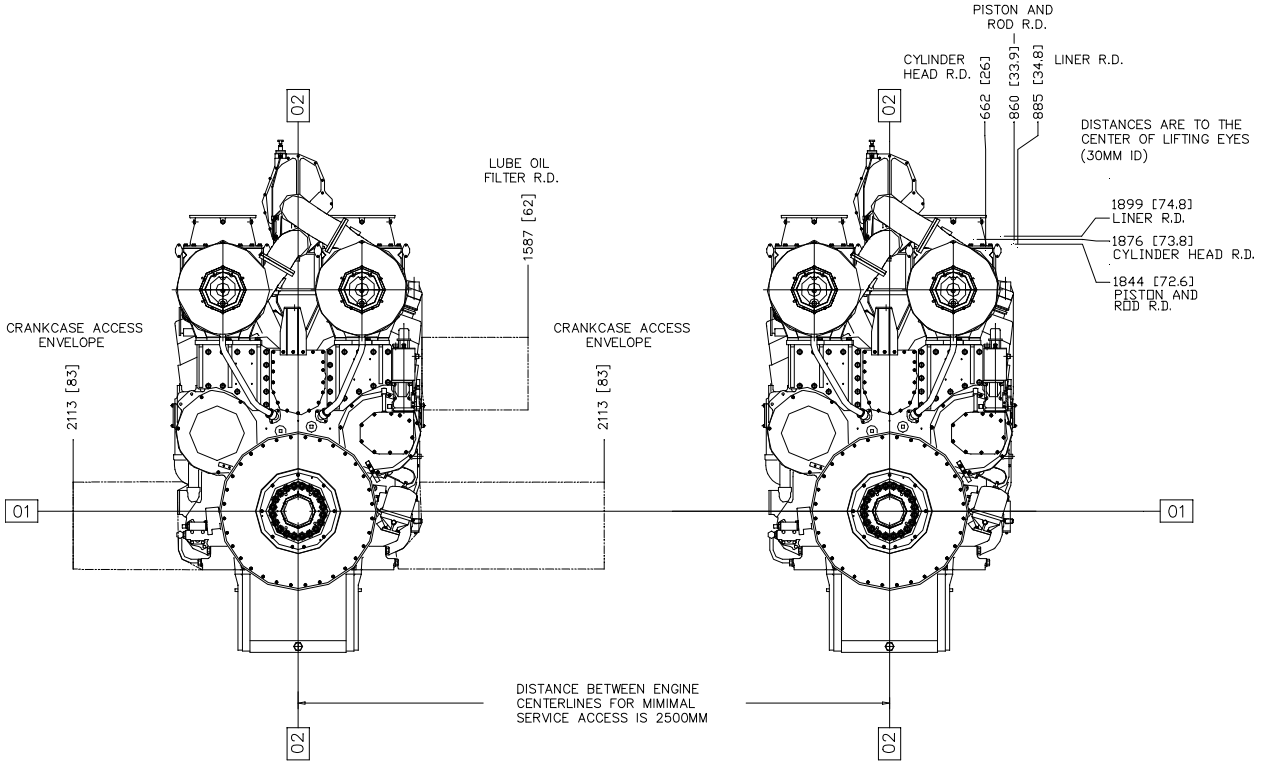
TYPICAL REMOVAL DISTANCES (R.D.)





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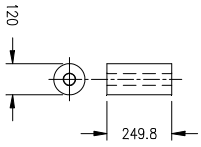
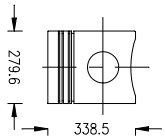
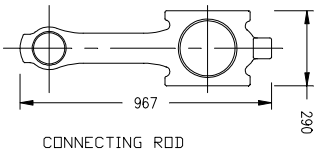


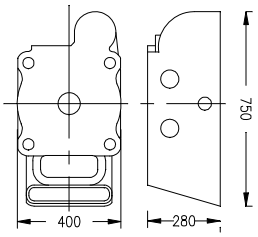
PISTON PIN
SHIPPING WEIGHT 19.1 kg



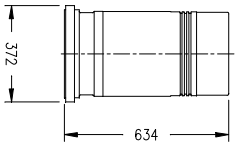
PISTON
SHIPPING WEIGHT 35.2 kg



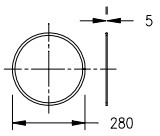
CONNECTING ROD
SHIPPING WEIGHT 56.2 kg



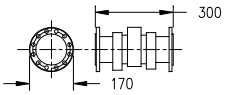
CYLINDER HEAD ASSEMBLY
SHIPPING WEIGHT 235 kg



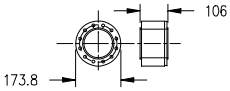
CYLINDER LINER
SHIPPING WEIGHT 127.9 kg



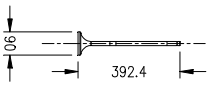
PISTON RING
SHIPPING WEIGHT .3 kg



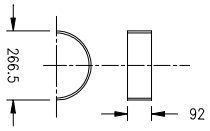
CAMSHAFT SEGMENT
SHIPPING WEIGHT 30.0 kg



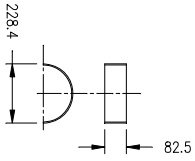
CAM JOURNAL
SHIPPING WEIGHT 13.6 kg



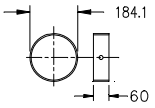
VALVE
SHIPPING WEIGHT 1.4 kg



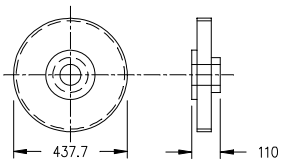
MAIN CRANKSHAFT BEARING
SHIPPING WEIGHT 4.5 KG



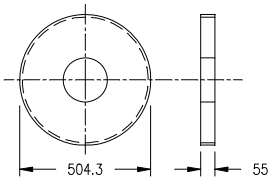
CONNECTING ROD BEARING
SHIPPING WEIGHT 2.3 kg



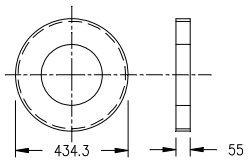
CAM BEARING
SHIPPING WEIGHT 1.4 kg



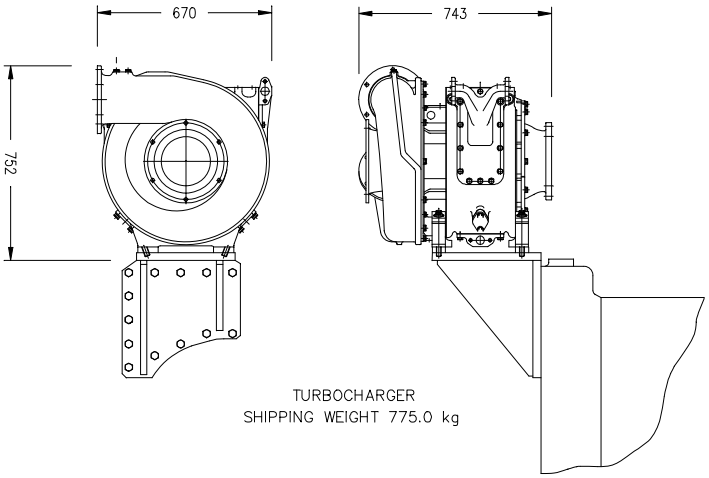
CAMSHAFT DRIVE GEAR
SHIPPING WEIGHT 43.5 kg



IDLER GEAR
SHIPPING WEIGHT 35.4 kg



CRANKSHAFT GEAR
SHIPPING WEIGHT 37.6 kg



TURBOCHARGER
SHIPPING WEIGHT 775.0 kg

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C280/3600 Witness Test Description

Caterpillar C280/3600 engines have an option for Witness Testing to be conducted in the Lafayette Package test cells. No customers or dealer personnel are allowed in the test cell while the engines are running, and no customer instrumentation may be connected to the engines, packages, or test cell data acquisition and reporting systems.

Standard testing includes a load test, transient response test, and vibration test, described as follows.

1. The load test uses 0.8 PF unless otherwise noted, and is recorded at 30 minute intervals.
   - 30 minutes @ 50% rated load
   - 30 minutes @ 75% rated load
   - 120 minutes @ 100% rated load
   - 60 minutes @ 110% rated load, 1.0 PF

The cylinder and exhaust temperatures are manually recorded. All other data is recorded electronically and printed by computer.

The transient response test is performed at 0.8 PF with load stepping from 0% to 100% ekW, with pre-determined intervals depending on engine frequency, then back to 0%, with examples as follows:

- For 900 rpm (60 Hz) C280-16 or 3616 engines:
  - 0% - 1700 ekW - 2880 ekW - 3840 ekW - 100% - 0%
- For 1000 rpm (50 Hz) C280-16 or 3616 engines:
  - 0% - 1900 ekW - 3210 ekW – 4275 ekW - 100% - 0%

2. The vibration test is taken at 0% and 100% load, and printed by computer. This is a 14-point, 1-dimensional test around the operating genset package to ensure no unusual vibration is occurring on the as-built configuration.

The standard testing also includes the following data as obtained through the data acquisition system.

Performance Data:

- rpm
- Real Power (ekW)
- Reactive Power (kVAR)
- Power Factor
- Frequency
- Fuel Rate (g/min)
- Specific Fuel Consumption (g/min)

Electrical data:

- Voltage A-B
- Voltage B-C
- Voltage C-A
- Average Voltage
- Current Phase A
- Current Phase B
- Current Phase C
- Average Current

Pressures (kPa):

- JW Pump Inlet
- JW Pump Outlet
- AC Outlet
- Engine Fuel
- Supply Fuel
- Oil
- Boost
- AC/OC Pump In

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- AC/OC Pump Out

Generator RTD:

- Stator Phase A
- Stator Phase B
- Stator Phase C
- Front Bearing
- Rear Bearing

Temperatures (Deg C):

- JW Inlet
- JW Outlet
- Oil
- Inlet Manifold
- AC Outlet
- AC/OC In
- AC/OC Out
- Inlet Fuel
- Inlet Air
- Turbocharger Outlet

General Information:

- Customer Name
- Test Date
- ESO Number

Engine Data:

- Engine Serial Number
- Engine Arrangement
- E Model
- Engine
- Engine Setting (bkW, rpm)
- OT or 2T

Generator Data:

- Generator Serial Number
- Generator Arrangement
- Volts/Phase/Hertz
- ekW
- ekVA
- Power Factor

Test Operation Data:

- Test Cell (East or West)
- Test Cell Operator

Test Conditions:

- Barometer (kPa)
- Dew Point (deg C)
- Fuel Density (degree API)

Lastly, the following temperatures are recorded during load testing at 50%, 75%, 100% (3 separate recordings at this load), and 110% (2 separate recordings at this load) power:

- Exhaust Manifold (Left)
- Exhaust Manifold (Right)
- Cylinders 1 through 16 individually, or as a function of total cylinder count (6, 8, or 12)

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Maintenance Interval Schedule

Ensure that all safety information, warnings, and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance, including all adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Use mileage, fuel consumption, service hours, or calendar time, whichever occurs first, in order to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance.

Every Service Hour

- Trend Data - Record

Daily

- Air Starting Motor Lubricator Oil Level - Check
- Air Tank Moisture and Sediment - Drain
- Cooling System Coolant Level - Check
- Driven Equipment – Inspect/Replace/Lubricate
- Engine Air Cleaner Service Indicator - Inspect
- Engine Air Precleaner - Clean
- Engine Oil Level - Check
- Fuel System Primary Filter/Water Separator - Drain
- Fuel Tank Water and Sediment - Drain
- Instrument Panel – Inspect
- Walk-Around Inspection

Every Week

- Jacket Water Heater - Check

Every 250 Service Hours

- Cooling System Coolant Sample (Level 1) – Obtain
- Cooling System Supplemental Coolant Additive (SCA) – Test/Add

Every 250 Service Hours or 6 Weeks

- Air Shutoff – Test
- Engine Oil Sample – Obtain
- Oil Mist Detector - Check

Every 500 Service Hours or 3 Months

- Engine Mounts – Inspect
- Engine Protective Devices - Check

Initial 1000 Service Hours or 6 Months

- Engine Valve Bridge, Lash, and Injector Fuel Timing – Check/Adjust
- Engine Valve Rotators - Inspect

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Every 1000 Service Hours or 6 Months

- Barring Device – Lubricate
- Cooling System Coolant Sample (Level 2) – Obtain
- Engine Mounts – Check
- Engine Oil Filter – Change
- Exhaust Piping – Inspect
- Fuel System Primary Filter/Water Separator Element – Replace
- Fuel system Secondary Filter – Replace
- Prelube Pump – Lubricate
- Speed Sensor – Clean/Inspect

Every 2000 Service Hours

- Air Starting Motor Lubricator Bowl - Clean

Every 2000 Service Hours or 1 Year

- Aftercooler Condensation – Drain
- Engine Valve Bridge, Lash, and Injector Fuel Timing – Check/Adjust
- Engine Valve Rotators – Inspect
- Oil Mist Detector – Clean/Replace

Every 4000 Service Hours or 1 Year

- Aftercooler Core – Clean/Test
- Starting Motor – Inspect
- Water Temperature Regulator - Replace

Every 8000 Service Hours or 1 Year

- Engine Protection Devices - Calibrate

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Every 8000 Service Hours or 3 Years

- Camshaft Roller Followers – Inspect
- Cooling System Coolant (DEAC) – Change
- Cooling System Coolant Extender (ELC) – Add
- Crankshaft Vibration Damper – Inspect
- Driven Equipment – Check
- Engine Oil Temperature Regulator – Replace
- Exhaust Shields – Inspect
- Turbocharger – Inspect
- Water Pump - Inspect

Between 16,000 and 24,000 Service Hours

- Top End Overhaul

Every 16,000 Service Hours or 6 Years

- Cooling System Coolant (ELC) - Change

Between 36,000 and 44,000 Service Hours

- Major Overhaul

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Storage Preservation Specification

This specification describes methods and materials used to provide for the preservation of engines as defined in Caterpillar Document No. 1E2566, Processing – Engine Preservation. These procedures are intended for all C280/3600 engines.

Preservation Procedures

1E2566L Processing (After Assembly and Test)

- All parts should be prepared and painted according to 1E2001.
- Fill Engine Jacket Water (EJW) system with a solution of 20% VCI 379 and 80% water or equivalent solution. A regulator bypass line must be used to allow filling on both sides of the regulator. Vent and EJW system at the highest point possible to assure complete filling.
- For engines with Separate Circuit Aftercooler (SCAC) systems fill the SCAC system with a solution of 20% VCI 379 and water or equivalent solution. Vent the SCAC system at the highest point possible to assure complete filling.
- Drain the VCI solution from the EJW system at multiple locations to assure complete drainage. (EJW pump, 10° block face cover, oil cooler, etc.)
- Drain the VCI solution from engines with SCAC system at the SCAC water pump. Close all EJW and SCAS system openings with the parts specified on engineering drawings.
- Spray a mixture of 50% 1 E2359 VCI oil and 50% engine oil into the air intake or turbocharger inlet. Minimum application rate is 7.5 mL/L of engine displacement. Install covers specified on engineering drawing to seal in VCI vapors.
- Spray a mixture of 50% 1E2359 VCI oil and 50% engine oil into the exhaust opening. Minimum application rate is 7.5 mL/L of engine displacement. Install covers specified on engineering drawing to seal in VCI vapors.
- Fill oiler reservoir for air starter with a mixture of 50% 1 E2359 VCI Oil and 50% engine oil.
- All other lubricating oil compartments are to be protected by 1E2359 VCI Oil by one of the following methods:
- Run the engine for the final 3 to 5 minutes with oil which has 3 to 4% of 1 E2359 VCI Oil by volume. This oil may be drained or left in the engine. Seal VCI vapors in the engine with covers specified on engineering drawings.
- The vapor phase of the VCI oil evaporates rapidly at engine operating conditions. If further instructions are needed, consult with the Engineering Materials Section of the Engine Division.
- Install a mixture of 50% 1 E2359 VCI Oil and 50% engine oil in the lubricating oil compartments at the rate of 1 part of mixture per 15 parts of compartment capacity at full level. Seal VCI vapors in the engine with covers specified on engineering drawings.
- This method can be used with an empty or partially filled lubricating oil compartment. If the compartment is already full, it may be necessary to drain some lubricant to facilitate the addition of the mixture.

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- Install 30 mL of a mixture of 50% 1 E2359 VCI and 50% engine oil in each cylinder and rotate crankshaft two turns. Tighten all fittings to the correct torque. Check the fuel system to verify that it is full of fuel. Install covers specified on engineering drawing to seal in fuel and vapors.
- Spray a thin film of mixture of 50% 1 E2359 VCI Oil and 50% engine oil on the flywheel, ring gear, and starter pinion. To seal in vapors, install the covers specified on engineering drawings for the flywheel housing and starter opening, and the plugs specified for through holes.
- Apply a heavy coating of 1 E0325 Grease to the bearing surfaces of all pin and joint connections and other non-painted surfaces.
- All tapped holes must be protected by painting or by applying MS2254 Coating or equivalent. Tapped holes shall be free of water before applying MS2254 Coating or equivalent and sealed with a tightly fit plastic plug or equivalent.

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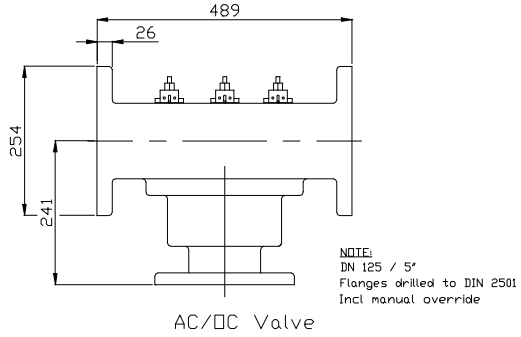
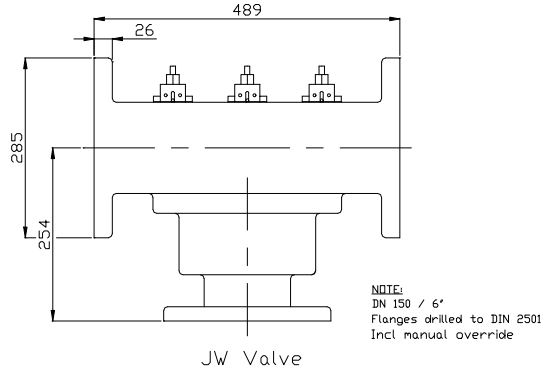
Typical Supplied Auxiliary Equipment

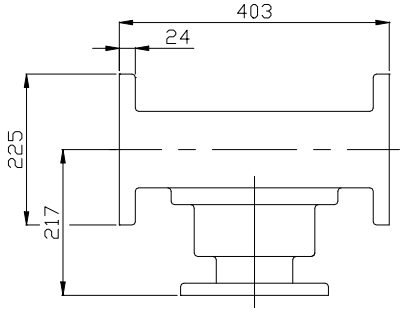
AC/OC Thermostatic Valve



JW Thermostatic Valve



Lube Oil Thermostatic Valve



NOTE:
DN 100 / 4"
No manuel override
Flanges drilled to DIN 2501

Lube Oil Valve

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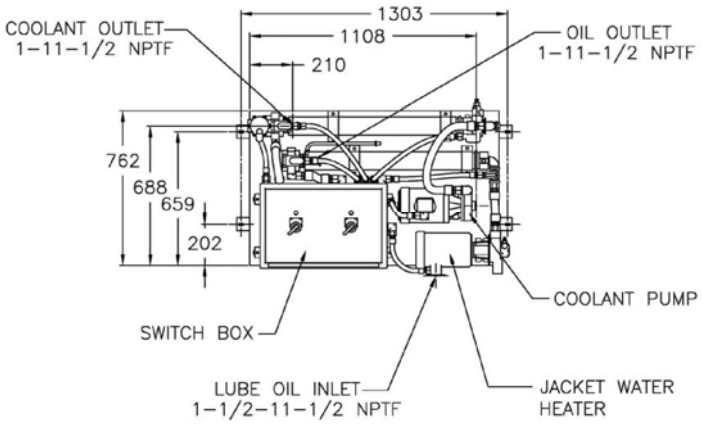
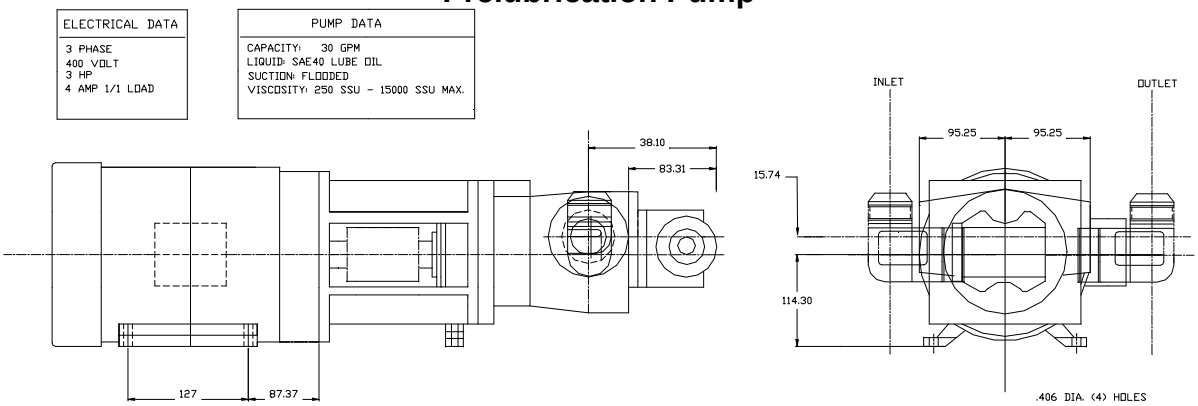
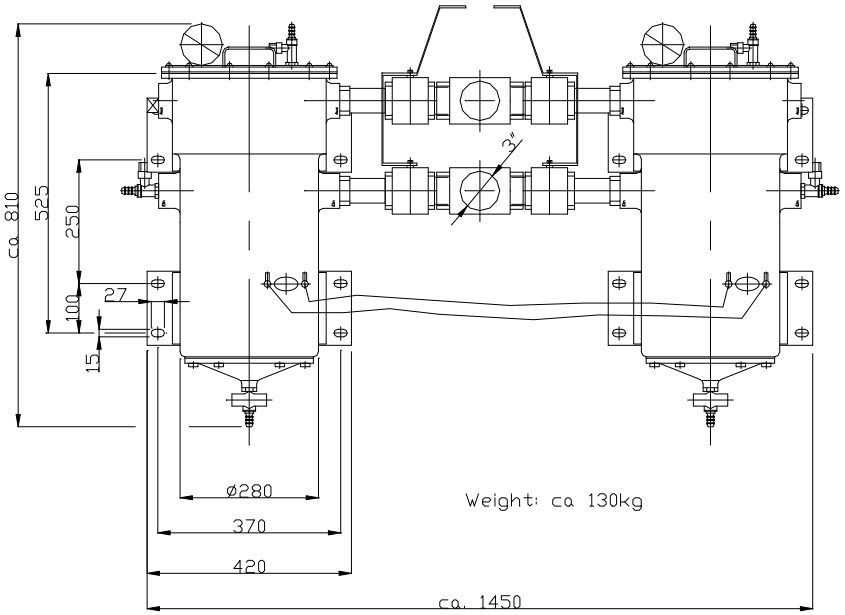
Jacket Water/Lube Oil Combination Heater



Prelubrication Pump



Fuel Pre Filter



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Reference Material

The following information is provided as additional reference to subjects discussed in this guide.

LEBW4985
C280 Commissioning Guide

SENR3593
Systems Operation, Testing and Adjusting (3612 and 3616 Engines)

SEBU6965
Operation and Maintenance Manual (3600 Distillate Fuel Engines)

SEBU7003
3600 Series and C280 Series Diesel Engine Fluids Recommendations

1E2566L
Processing – Engine Preservation

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LEBW0006-00

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